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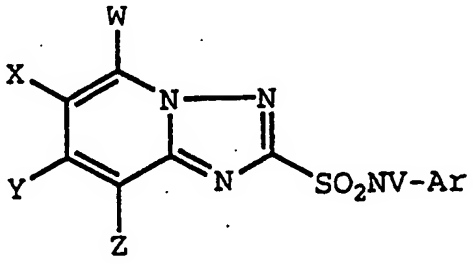
(54) Title: N-ARYL[1,2,4]TRIAZOLO[1,5-a]PYRIDINE-2-SULFONAMIDE HERBICIDES

(57) Abstract

Substituted N-aryl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide compounds of formula (I), such as N-(2,6-difluorophenyl)-5-methoxy-7-methyl[1,2,4]triasolo-[1,5-a]pyridine-2-sulfonamide, N-(4-bromo-1-methyl-3-pyrazolyl)-8-chloro-5-methoxy[1,2,4]triasolo[1,5-a]pyridine-2-sulfonamide, and N-(2-fluoro-4-methyl-3-pyridinyl)-8-ethoxy-6-chloro[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, were prepared by condensation of a 2-chlorosulfonyl[1,2,4]-triazolo[1,5-a]pyridine compound with an aryl amine. The compounds prepared were found to possess excellent herbicidal activity on a broad spectrum of vegetation at low application rates.



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N-ARYL[1,2,4]TRIAZOLO[1,5-a]PYRIDINE-2-SULFONAMIDE HERBICIDES

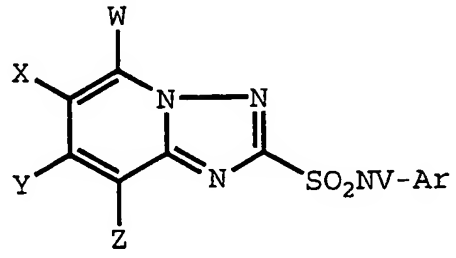
The present invention relates to substituted sulfonamide compounds, to herbicidal compositions containing the compounds, and to the utility of the compounds for the control of unwanted vegetation.

The control of unwanted vegetation by means of chemical agents, i.e., herbicides, is an important aspect of modern agriculture and land management. While many chemicals that are useful for the control of unwanted vegetation are known, new compounds that are more effective generally, are more effective for specific plant species, are less damaging to desirable vegetation, are safer to man or the environment, are less expensive to use, or have other advantageous attributes are desirable.

A number of sulfonamide compounds, including certain substituted [1,2,4]triazolo[1,5-a]pyrimidine-2-sulfonamide compounds (U.S. Patent 4,954,163), and [1,2,4]triazolo[1,5-c]pyrimidine-2-sulfonamide compounds (U.S. Patent 5,010,195 and European Application 244,948) are known and are known to possess herbicidal activity, especially on broadleaf weeds.

It has now been found that certain N-aryl[1,2,4]triazolo[1,5-a]-pyridine-2-sulfonamide compounds are potent herbicides for the control of unwanted vegetation, have desirable crop selectivity, and have favorable toxicological and environmental attributes.

The invention includes N-aryl[1,2,4]triazolo[1,5-a]pyridine-2--sulfonamide compounds of Formula I:

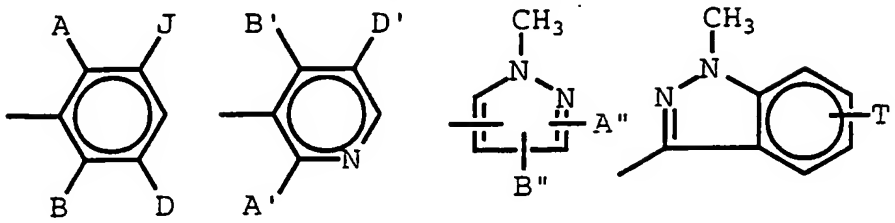


wherein

W, X, Y, and Z each independently represents H, CH_3, CH_2CH_3, CH_2OCH_3, CF_3, F, Cl, Br, I, OCH_2CF_3, $S(C_1-C_3)$alkyl, or $O(C_1-C_3)$alkyl optionally monosubstituted with F, Cl, or OCH_3, with the proviso that at least one of W, X, Y, and Z represents H;

V represents H, COR', $CO_2R"$, or CONR"'2;

Ar represents an aromatic moiety one of the formulas:



A represents F, Cl, Br, $CO_2R"$, CONR"'2, (C_1-C_2)haloalkyl, NO_2, CN, SOR', or SO_2R';

B represents H, CH_3, C_2H_5, F, Cl, Br, CN, OR', SR', NR"'2, phenyl, or phenoxy, each phenyl and phenoxy optionally possessing 1 to 3 substituents selected from the group consisting of F, Cl, Br, CN, CF_3, NO_2, and CH_3;

D and J each independently represents H or CH_3 with the proviso that at least one of D and J represents H;

A' and B' each independently represents H, R', OR', OCH_2CH_2Cl, $OCH_2CH_2OCH_3$, $S(O)_nR'$, F, Cl, Br, I, CN, NO_2, C_6H_5, $CO_2R"$, or CONR"'2 with the proviso that not more than one of A' and B' represents H;

D' represents H, F, Cl, Br, I, CF_3, or CH_3;

A" represents F, Cl, Br, I, CF_3, SCF_3, CN, $CO_2R"$, or CONR"'2 and is located in the 4-position when the point of attachment is the 3- or 5-position and represents F, Cl, Br, I, CF_3, or CH_3 and is located in the 3- or 5-position when the point of attachment is the 4-position;

B" represents H when the point of attachment is the 3- or 5-position and represents H, Cl, Br, F, CH_3, or OCH_3 and is located the 3- or 5-position not occupied by A" when the point of attachment is the 4-position;

T represents H or F;

n represents 0, 1, or 2;

R' represents (C_1-C_4)alkyl optionally singly to completely substituted with fluorine;

R" represents (C_1-C_4)alkyl, (C_3-C_4)alkenyl, or (C_3-C_4)alkynyl;

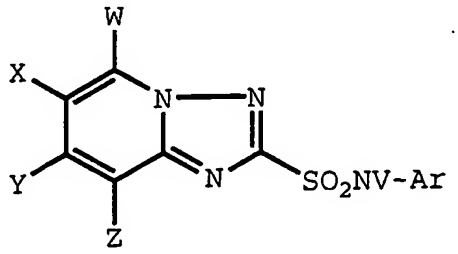
R"' represents H or (C_1-C_4)alkyl; and

when V represents H, the agriculturally acceptable salts thereof.

The compounds of the invention, usually in the form of an herbicidal composition containing one or more of them in admixture with an agriculturally acceptable adjuvant or carrier, exhibit strong herbicidal properties when applied either directly to the unwanted vegetation or to the locus thereof and when applied either preemergence or postemergence.

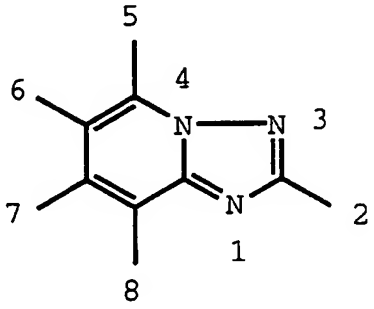
The invention includes certain intermediates that are useful in the preparation of the herbicidal compounds of the invention.

The herbicidal compounds of the invention are N-aryl[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide compounds of Formula I:



These compounds can be described as amides derived from substituted [1,2,4]triazolo[1,5-a]pyridine-2-sulfonic acid compounds and substituted aromatic amine compounds, such as anilines, aminopyridines, aminopyrazoles, and aminoindazoles.

The Chemical Abstracts nomenclature numbering system for [1,2,4]triazolo[1,5-a]pyridine ring compounds is as follows:



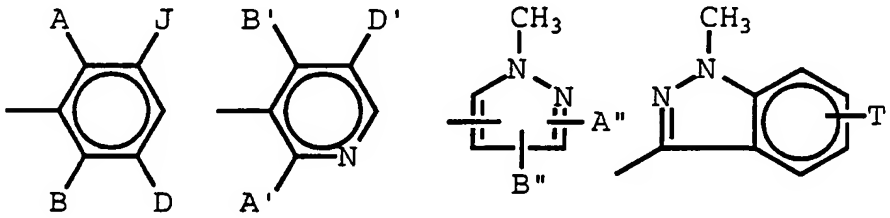
Thus, the compounds of the invention are 2-sulfonamide compounds and the W substituents are in the 5-position, the X substituents are in the 6-position, the Y substituents are in the 7-position, and the Z substituents are in the 8-position.

The compounds of the invention include those of Formula I wherein up to three of W, X, Y, and Z independently represent CH_3, CH_2CH_3, CH_2OCH_3, CF_3, F, Cl, Br, I, OCH_2CF_3, $S(C_1-C_3)$alkyl, or $O(C_1-C_3)$alkyl optionally monosubstituted with F, Cl, or OCH_3 and the remaining one to four of W, X, Y, and Z represent hydrogen. Compounds wherein two of W, X, Y, and Z represent hydrogen are usually preferred. Compounds wherein one or both of W and Z represents methoxy or wherein one of W and Z represents ethoxy or isopropoxy are, further, typically preferred. Those wherein W

represents methoxy or ethoxy are typically more preferred. Compounds of Formula I wherein W represents methoxy, ethoxy, or isopropoxy, X and Z each represent hydrogen, and Y represents methyl or a halogen; or wherein W represents methoxy or ethoxy, X and Y each represent hydrogen, and Z represents methyl, methoxy, or a halogen; or wherein Z represents methoxy or ethoxy, W and Y each represent hydrogen, and X represents methyl, trifluoromethyl, or a halogen are often of special interest.

V represents hydrogen or an acyl derivative, such as $CO(C_1$-$C_4)$alkyl optionally singly to completely substituted with fluorine, $CO_2(C_1$-$C_4)$alkyl, $CO_2(C_3$-$C_4)$alkenyl, $CO_2(C_3$-$C_4)$alkynyl, $CON((C_1$-$C_4)alkyl)_2$, $CONH(C_1$-$C_4)$alkyl, or $CONH_2$. Hydrogen is generally preferred. When V represents hydrogen, the invention includes the agriculturally acceptable salts obtained by neutralizing the resulting acid with a base.

The term Ar in Formula I represents an aromatic moiety, especially an aromatic moiety of one the following formulas:



which includes phenyl moieties, 3-pyridinyl moieties, 1-methyl-(3-, 4-, or 5-)pyrazolyl moieties, and 1-methyl-3-indazolyl moieties.

When Ar represents a phenyl moiety, the moiety is substituted in at least one ortho position with an electron withdrawing group. Compounds of Formula I wherein Ar represents a substituted phenyl moiety include those wherein A represents F, Cl, Br, $CO_2R"$, $CONR'"_2$, $(C_1$-$C_2)$haloalkyl, NO_2, CN, SOR', or SO_2R'; B represents H, CH_3, C_2H_5, F, Cl, Br, CN, OR', SR', $NR"'_2$, phenyl, or phenoxy, each phenyl and phenoxy optionally possessing 1 to 3 substituents selected from the group consisting of F, Cl, Br, CN, CF_3, NO_2, and CH_3; and D and J each independently represents H or CH_3 with the proviso that at least one of D and J represents H. Compounds wherein A represents F, Cl, Br, CF_3, NO_2, or CO_2CH_3; B represents F, Cl, Br, OCH_3, or CH_3; J represents H; and D represents H or CH_3 are often preferred. Compounds wherein A and B both represent F or Cl and D and J both represent H, wherein A and B both represent F or Cl, D represents CH_3, and D represents H, wherein A represents CO_2CH_3, B represents Cl or F, and

D and J both represent H, and wherein A represents CF_3, B represents OCH_3, and D and J both represent H are often more preferred.

When Ar represents a 3-pyridinyl moiety, the moiety is substituted in at least one of the 2- and 4-positions. Compounds that are substituted in both of these positions are often preferred. Compounds of Formula I wherein Ar represents a substituted 3-pyridinyl moiety include those wherein A' and B' are selected from H, F, Cl, Br, I, CN, NO_2, C_6H_5, CO_2R^*, $CONR'^*_2$, 2-chloroethoxy or 2-methoxyethoxy, or (C_1-C_4)alkyl, (C_1-C_4)alkoxy, (C_1-C_4)alkylthio, (C_1-C_4)alkylsulfinyl, or (C_1-C_4)-alkylsulfonyl each optionally singly to completely substituted with flucrine, and D' represents H, F, Cl, Br, I, CF_3, or CH_3. Compounds wherein A' represents CH_3, O(C_1-C_3)alkyl, F, Cl, Br, or I; B' represents F, Cl, Br, I, CH_3, C_2H_5, CF_3, O(C_1-C_3)alkyl, $OCH(CH_3)CF_3$, OCH_2CH_2F, OCH_2CHF_2 or CO_2(C_1-C_3)alkyl; and D' represents H are often preferred. Such compounds wherein A' represents Br, Cl, F, or OCH_3, B' represents CH_3, OCH_3, OC_2H_5, OC_3H_7(n), OC_3H_7(i), $OCH(CH_3)CF_3$, or OCH_2CH_2F, and D' represents H; or wherein A' represents OCH_3 or OC_2H_5, B' represents CO_2(C_1-C_2)alkyl, Br, Cl, or F, and D' represents H are typically more preferred. 3-Pyridinyl moieties wherein A' represents F, Cl, Br, or OCH_3, B' represents CH_3, OCH_3, OC_2H_5, OC_3H_7(n), OC_3H_7(i), $OCH(CH_3)CF_3$, or OCH_2CH_2F, and D' represents H are sometimes especially preferred. 3-Pyridinyl moieties are often preferred Ar moieties.

When Ar represents a pyrazolyl moiety, the moiety is attached to the sulfonamide nitrogen atom at a 3-, 4-, or 5-position and has a methyl group in the 1-position. When the point of attachment is the 3- or 5-position, the moiety is substituted in the 4-position with an electron withdrawing group. The 3- or 5-position attachment compounds wherein the 4-position substituent A" represents F, Cl, Br, I, CF_3, SCF_3, CN, CO_2R^*, and $CONR'^*_2$ (B" represents H) are specifically identified. Those wherein A" represents Cl, Br, I, or CF_3 are usually more preferred. When the point of attachment is the 4-position, the moiety is substituted in one or both of the 3- and 5-positions. Such compounds wherein the 3- or 5-position substituent A" represents F, Cl, Br, I, CF_3, and CH_3 and the other 3- or 5-position substituent B" represents H, Cl, Br, F, CH_3, or OCH_3 are specifically identified. Pyrazolyl moieties wherein A" represents Cl, Br, I, or CF_3 and B" represents H are often preferred.

When Ar represents an indazolyl moiety, the moiety is attached to the sulfonamide nitrogen atom at the 3-position, has a methyl group in

the 1-position, and is optionally mono-substituted with fluorine. Such compounds having a fluoro substituent in the 4-position are often preferred.

The term alkyl as used herein includes straight chain, branched chain, and cyclic moieties. Thus, typical alkyl groups are methyl, ethyl, 1-methylethyl, propyl, cyclopropyl and the like. Methyl and ethyl are often preferred. Typical alkyl groups singly to completely substituted with fluorine include trifluoromethyl, monofluoromethyl, 2,2,2-trifluoroethyl, 2,3-difluoropropyl, and the like; trifluoromethyl is often preferred. The term haloalkyl is used herein to denote alkyl singly to completely substituted with fluorine or chlorine and includes trifluoromethyl, dichloromethyl, 2,2-difluoro-2-chloroethyl, and the like; trifluoromethyl is often preferred. The term halogen includes fluorine, chlorine, bromine, and iodine.

The term "agriculturally acceptable salts" is employed herein to denote compounds wherein the acidic sulfonamide proton of the compound of Formula I is replaced by a cation which itself is neither herbicidal to crop plants being treated nor significantly deleterious to the applicator, the environment, or the ultimate user of any crop being treated. Suitable cations include, for example, those derived from alkali or alkaline earth metals and those derived from ammonia and amines. Preferred cations include sodium, potassium, magnesium, and aminium cations of the formula:

$$R^6R^7R^8NH^{\oplus}$$

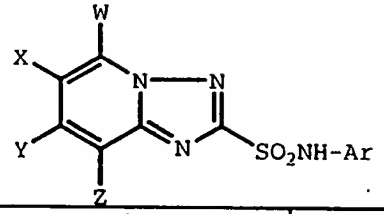
wherein R^6, R^7, and R^8 each, independently represents hydrogen or $(C_1$-$C_{12})$alkyl, $(C_3$-$C_{12})$cycloalkyl, or $(C_3$-$C_{12})$alkenyl, each of which is optionally substituted by one or more hydroxy, $(C_1$-$C_8)$alkoxy, $(C_1$-$C_8)$alkylthio or phenyl groups; provided that R^6, R^7, and R^8 are sterically compatible. Additionally, any two of R^6, R^7, and R^8 together may represent an aliphatic difunctional moiety containing 1 to 12 carbon atoms and up to two oxygen or sulfur atoms. Salts of the compounds of Formula I can be prepared by treatment of compounds of Formula I wherein V represents hydrogen with a metal hydroxide, such as sodium hydroxide, potassium hydroxide, or magnesium hydroxide, or an amine, such as ammonia, trimethylamine, hydroxyethylamine, bisallylamine, 2-butoxyethylamine, morpholine, cyclododecylamine, or benzylamine.

While each of the N-aryl[1,2,4]triazolo[1,5-a]pyridine-2--sulfonamide compounds encompassed by Formula I is within the scope of the invention, the degree of herbicidal activity and the spectrum of weed control obtained varies depending upon the substituents present and, consequently, certain of the compounds are preferred. The compounds that are preferred in any specific situation further depends on the identity of the undesirable vegetation to be controlled, climatic factors, whether total or selective vegetation control is desired, and other factors.

A listing of some typical compounds of the invention is given in Table 1. Some of the specifically preferred compounds of the invention include: N-(2,6-dichloro-3-methylphenyl)-5-methoxy-7-methyl[1,2,4]triazolo-[1,5-a]pyridine-2-sulfonamide, N-(2,3-dimethyl-6-nitrophenyl)-5-methoxy-7--methyl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-fluoro-4-methyl-3--pyridinyl)-5-methoxy-7-methyl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-chloro-4-ethoxy-3-pyridinyl)-5-methoxy-7-methyl[1,2,4]triazolo[1,5-a]-pyridine-2-sulfonamide, N-(2-chloro-4-methyl-3-pyridinyl)-5-methoxy-7-methyl-[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(4-bromo-1-methyl-3-pyrazolyl)--5-methoxy-7-methyl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-methyl-6--nitrophenyl)-5-ethoxy-7-methyl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-methoxy-6-(trifluoromethyl)phenyl)-5-ethoxy-7-methyl[1,2,4]triazolo[1,5-a]-pyridine-2-sulfonamide, N-(2,6-difluorophenyl)-8-chloro-5-methoxy[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-fluoro-4-methyl-3-pyridinyl)-8--chloro-5-methoxy[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-fluoro-4--methyl-3-pyridinyl)-7-chloro-5-methoxy[1,2,4]triazolo[1,5-a]pyridine-2--sulfonamide, N-(4-bromo-1-methyl-3-pyrazolyl)-7-chloro-5-methoxy[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-fluoro-4-methyl-3-pyridinyl)-7--chloro-5-ethoxy[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(4-bromo-1--methyl-3-pyrazolyl)-8-methoxy[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(4-bromo-1-methyl-3-pyrazolyl)-6-chloro-8-methoxy[1,2,4]triazolo[1,5-a]-pyridine-2-sulfonamide, N-(2,6-dichlorophenyl)-6-bromo-8-methoxy[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-fluoro-4-methyl-3-pyridinyl)-6--bromo-8-methoxy[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-methyl-6--nitrophenyl)-7-methyl-5-(2,2,2-trifluoroethoxy)[1,2,4]triazolo[1,5-a]pyridine--2-sulfonamide, N-(2-methyl-6-nitrophenyl)-5-chloro-7-methyl[1,2,4]triazolo-[1,5-a]pyridine-2-sulfonamide, and N-(2-chloro-4-methoxy-3-pyridinyl)-5,7--dimethoxy[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide.

TABLE 1

N-ARYL[1,2,4]TRIAZOLO[1,5-A]PYRIDINE-2-SULFONAMIDE COMPOUNDS



Cpd. No.	W	X	Y	Z	Ar	Form	Melting point, °C	%C calc. found	%H calc. found	%N calc. found
1	H	H	H	H	2,6-dichlorophenyl	white powder	269-270	42.0 41.9	2.35 2.22	16.3 16.3
2	H	H	H	H	2,6-difluorophenyl	white powder	222-223	45.6 45.6	2.60 2.56	18.1 18.2
3	H	H	H	H	1-methyl-4-bromo--3-pyrazolyl	tan solid	229-231	33.6 34.0	2.54 2.55	23.5 23.2
4	H	H	CH_3	H	2,6-dichlorophenyl	tan powder	232-234	43.7 44.0	2.82 2.87	15.7 15.5
5	H	H	CH_3	H	2,6-difluorophenyl	white powder	231-232	48.1 48.1	3.11 2.97	17.3 17.4
6	H	H	CH_3	H	1-methyl-4-bromo--3-pyrazolyl	white solid	238-240	35.7 35.8	2.72 3.00	22.7 22.6
7	Cl	H	CH_3	H	2-fluoro-4-methyl--3-pyridinyl	yellow powder	253-255 (d)	44.0 44.2	2.84 3.09	19.7 19.7
8	OCH_3	H	CH_3	H	2-fluoro-4-methyl--3-pyridinyl	white powder	202-204 (d)	47.9 48.0	4.02 4.06	19.9 19.6
9	OCH_2CF_3	H	CH_3	H	2-fluoro-4-methyl--3-pyridinyl	white powder	249-250 (d)	43.0 43.2	3.12 3.21	16.7 16.6
10	Cl	H	CH_3	H	1-methyl-4-bromo--3-pyrazolyl	tan solid	262-264	32.6 30.7	2.48 2.59	20.7 20.7
11	Cl	H	CH_3	H	2,6-dibromophenyl	white powder	256-259	32.5 32.8	1.89 2.06	11.7 11.7
12	Cl	H	CH_3	H	2-methyl-6-methoxy-carbonylphenyl	white solid	198-202	48.7 48.6	3.83 4.20	14.2 14.0
13	OCH_2CH_3	H	CH_3	H	2-fluoro-4-methyl--3-pyridinyl	white powder	206-208.5	49.3 49.7	4.41 4.44	19.2 19.1
14	Cl	H	CH_3	H	2-fluoro-6-methoxy-carbonylphenyl	mauve powder	216-219	45.2 45.0	3.03 3.40	14.1 14.0

15	Cl	H	CH_3	H	1-methyl-3-indazolyl	tan solid	267-269	46.7 46.5	3.66 3.52	21.8 21.8
16	CH_3	H	CH_3	H	1-methyl-4-bromo-3-pyrazolyl	tan powder	229-232 (d)	37.4 38.1	3.40 3.62	21.8 21.6
17	CH_3	H	CH_3	H	2,6-dichlorophenyl	white powder	250-252	45.3 44.9	3.26 3.49	15.1 14.8
18	CH_3	H	CH_3	H	2,6-difluorophenyl	lt. tan powder	207-209	49.7 49.4	3.58 3.80	16.6 16.4
19	OCH_3	H	CH_3	H	1-methyl-4-bromo-3-pyrazolyl	white solid	251 (d)	35.9 36.0	3.27 3.05	20.9 20.9
20	OCH_3	H	CH_3	H	2-bromo-6-chloro-phenyl	white solid	>265	39.0 37.9	2.80 2.75	13.0 12.5
21	OCH_2CH_3	H	CH_3	H	2-bromo-6-chloro-phenyl	white solid	279	40.4 40.4	3.17 3.08	12.6 12.6
22	Cl	H	CH_3	H	2-bromo-6-fluoro-phenyl	tan solid	226	37.2 37.1	2.16 1.86	13.4 13.3
23	OCH_3	H	CH_3	H	2-bromo-6-fluoro-phenyl	white solid	253 (d)	40.5 40.3	2.91 3.13	13.5 13.7
24	OCH_2CH_3	H	CH_3	H	2-bromo-6-fluoro-phenyl	white solid	259 (d)	42.0 41.9	3.29 3.44	13.1 13.0
25	Cl	H	CH_3	H	2-methoxy-6-(trifluoromethyl)phenyl	white solid	231-232.5	42.8 42.9	2.87 3.00	13.3 13.5
26	Cl	H	CH_3	H	2,6-dichloro-3-methylphenyl	white solid	269-271	41.5 41.5	2.73 2.92	13.8 14.0
27	Cl	H	CH_3	H	2,6-difluoro-3-methylphenyl	white solid	224-226	45.1 45.1	2.97 2.62	15.0 15.2
28	OCH_3	H	CH_3	H	2-methoxy-6-(trifluoromethyl)phenyl	white solid	243-245	46.2 46.1	3.63 3.58	13.5 13.4
29	OCH_3	H	CH_3	H	1-methyl-3-indazolyl	tan solid	247-248	51.7 51.9	4.07 3.87	22.6 22.4
30	OCH_3	H	CH_3	H	2-chloro-6-methoxy-phenyl	white solid	145-146	47.1 47.0	3.95 3.97	14.6 14.6
31	OCH_3	H	CH_3	H	2,6-dichloro-3-methylphenyl	grey powder	150-151	44.9 45.2	3.52 3.58	14.0 14.0
32	OCH_3	H	CH_3	H	2,6-difluoro-3-methylphenyl	white powder	144-145	48.9 48.9	3.83 3.78	15.2 15.3
33	OCH_2CH_3	H	CH_3	H	2-chloro-6-methoxy-phenyl	grey powder	232-235	48.3 48.3	4.32 4.71	14.1 14.0
34	OCH_2CH_3	H	CH_3	H	2-methoxy-6-(trifluoromethyl)phenyl	white powder	246-247	47.4 47.4	3.98 4.03	13.0 13.0
35	OCH_2CH_3	H	CH_3	H	2,6-dichloro-3-methylphenyl	white powder	260-262	46.3 46.2	3.88 3.69	13.5 13.4

36	OCH_2CH_3	H	CH_3	H	2,6-difluoro-3-methylphenyl	white powder	240-243	50.3 50.2	4.22 4.38	14.7 14.6
37	OCH_2CH_3	H	CH_3	H	2-methyl-6-nitrophenyl	white solid	256 (d)	49.1 49.1	4.38 4.42	17.9 18.1
38	OCH_2CH_3	H	CH_3	H	2,3-dimethyl-6-nitrophenyl	yellow solid	255-256 (d)	50.4 50.4	4.72 4.88	17.3 17.2
39	OCH_2CH_3	H	CH_3	H	2-fluoro-5-methylphenyl	white crystals	238-239 (d)	52.7 52.5	4.70 4.62	15.4 15.5
40	OCH_2CH_3	H	CH_3	H	2-chloro-6-methylphenyl	white solid	253-255 (d)	50.5 50.5	4.50 4.58	14.7 14.9
41	OCH_2CH_3	H	CH_3	H	2-(trifluoromethyl)-phenyl	white solid	203-204.5	48.0 47.9	3.78 3.96	13.8 13.9
42	OCH_3	H	CH_3	H	2-methyl-6-nitrophenyl	yellow powder	231-233	47.7 48.1	4.01 4.29	18.6 18.6
43	OCH_3	H	CH_3	H	2,3-dimethyl-6-nitrophenyl	yellow powder	258-260	49.1 49.2	4.38 4.60	17.9 18.0
44	OCH_3	H	CH_3	H	2-fluoro-5-methylphenyl	white solid	229-230	51.4 51.7	4.32 4.56	16.0 16.2
45	OCH_3	H	CH_3	H	2-(trifluoromethyl)-phenyl	white powder	230-231	46.6 46.4	3.39 3.52	14.5 14.6
46	Cl	H	CH_3	H	2-fluoro-5-methylphenyl	white solid	213-214	47.4 47.5	3.41 3.44	15.8 15.8
47	OCH_3	H	CH_3	H	2-chloro-6-methylphenyl	white solid	253-255	49.1 49.3	4.12 4.24	15.3 15.3
48	OCH_2CF_3	H	CH_3	H	2-methyl-6-nitrophenyl	white solid	245-247 (d)	43.2 43.3	3.17 3.44	15.7 15.7
49	OCH_2CF_3	H	CH_3	H	2,3-dimethyl-6-nitrophenyl	yellow	242-243 (d)	44.5 44.4	3.51 3.72	15.2 15.1
50	OCH_2CF_3	H	CH_3	H	2-chloro-6-methylphenyl	white solid	215-217	44.2 44.0	3.25 3.49	12.9 12.8
51	OCH_3	H	CH_3	H	2-chloro-4-methyl-3-pyridinyl	tan powder	209-210 (d)	45.7 46.0	3.84 4.07	19.0 18.7
52	Cl	H	CH_3	H	2-chloro-4-methoxy-3-pyridinyl	yellow powder	219-221 (d)	40.2 40.6	2.86 3.08	18.0 18.0
53	OCH_3	H	CH_3	H	2-chloro-4-methoxy-3-pyridinyl	white powder	216-217 (d)	43.8 43.8	3.68 3.55	18.3 17.9
54	Cl	H	CH_3	H	2-chloro-4-methyl-3-pyridinyl	white powder	255-257 (d)	42.0 42.3	2.98 2.92	18.8 19.0
55	OCH_2CF_3	H	CH_3	H	2-chloro-6-iodophenyl	white powder	248	33.0 32.9	2.03 1.94	10.3 10.1
56	OCH_2CF_3	H	CH_3	H	2-fluoro-6-methoxycarbonylphenyl	tan solid	182	44.2 44.1	3.06 2.88	12.1 12.0

57	OCH_2CH_3	H	CH_3	H	2-fluoro-6-ethoxy-carbonylphenyl	tan solid	212	50.0 51.0	4.20 4.46	13.7 13.3
58	OCH_2CH_3	H	CH_3	H	2,6-dichlorophenyl	off-white solid	>275	44.9 42.6	3.52 3.55	14.0 13.3
59	OCH_2CF_3	H	CH_3	H	2,6-dibromophenyl	white powder	262	33.1 33.0	2.04 1.89	10.3 10.2
60	OCH_2CF_3	H	CH_3	H	2,6-dichlorophenyl	white powder		39.6 39.8	2.44 2.34	12.3 12.3
61	OCH_2CH_3	H	CH_3	H	2,6-difluorophenyl	tan powder	254-256	48.9 48.7	3.83 4.03	15.2 15.2
62	OCH_2CF_3	H	CH_3	H	2,6-fluorophenyl	white powder	267-269	42.7 39.5	2.63 2.57	13.3 12.3
63	OCH_2CF_3	H	CH_3	H	2-methoxy-6-(tri-fluoromethyl)phenyl	off-white powder	235-237 (d)	42.2 42.2	2.91 2.80	11.5 11.6
64	OCH_2CF_3	H	CH_3	H	4-bromo-1-methyl-5--pyrazolyl	tan solid	193-197	33.3 33.7	2.58 2.54	17.9 18.1
65	Cl	H	Cl	H	2,6-dichlorophenyl	lt. tan powder	246-248	35.0 34.8	1.47 1.25	13.6 13.5
66	OCH_3	H	Cl	H	2,6-dichlorophenyl	lt. tan powder	232-243 (d)	38.3 38.3	2.22 2.12	13.7 13.7
67	OCH_2CH_3	H	CH_3	H	2-chloro-6-fluoro-phenyl	white solid	>265	46.8 47.0	3.67 3.79	14.6 14.5
68	Cl	H	CH_3	H	2-bromo-6-chloro-phenyl	white solid	185-186	35.8 35.7	2.08 2.05	12.9 12.7
69	OCH_3	H	CH_3	H	2-chloro-6-fluoro-phenyl	off-white solid	245	45.4 45.5	3.26 3.42	15.1 14.9
70	OCH_2CF_3	H	CH_3	H	2-bromo-6-fluoro-phenyl	white powder	>300	37.3 37.4	2.29 2.15	6.64 6.75
71	OCH_2CF_3	H	CH_3	H	2-chloro-6-fluoro-phenyl	white solid	248	41.1 41.0	2.53 2.46	12.8 12.8
72	OCH_2CH_3	H	CH_3	H	2-chloro-6-iodophenyl	white powder	>263	36.6 36.7	2.86 2.58	11.4 11.4
73	OCH_3	H	CH_3	H	2-chloro-6-iodophenyl	white powder	>247	35.1 35.4	2.53 2.23	11.7 11.5
74	Cl	H	CH_3	H	2-methyl-6-nitro-phenyl	yellow powder	256-258	44.0 44.1	3.17 3.23	18.3 18.6
75	Cl	H	CH_3	H	2,3-dimethyl-6-nitro-	yellow solid	281-283	45.5 45.7	3.57 3.73	17.7 17.7
76	Cl	H	CH_3	H	2-chloro-6-methyl-phenyl	white solid	258-260	45.3 45.2	3.26 3.21	15.1 15.1
77	Cl	H	CH_3	H	2-(trifluoromethyl)-phenyl	white solid	196-198	43.0 42.9	2.58 2.72	14.3 14.5

78	Cl	H	CH_3	H	2,6-dichlorophenyl	white powder	257-258 (d)	39.9 39.8	2.32 2.35	14.3 14.3
79	Cl	H	CH_3	H	2,6-difluorophenyl	yellow powder	213-214	43.5 43.5	2.53 2.51	15.6 15.7
80	OCH_3	H	CH_3	H	2,6-dichlorophenyl	white powder	269-270 (d)	43.4 43.3	3.13 3.13	14.5 14.4
81	OCH_3	H	CH_3	H	2,6-difluorophenyl	tan powder	248-249 (d)	47.5 47.4	3.41 3.48	15.8 15.8
82	OCH_3	H	CH_3	H	2-fluoro-6-methoxy-carbonylphenyl	mauve solid	220-221 (d)	48.7 48.9	3.83 3.82	14.2 14.2
83	OCH_3	H	CH_3	H	2,6-dibromophenyl	white solid	270 (d)	35.3 35.5	2.54 2.72	11.8 11.8
84	OCH_2CH_3	H	CH_3	H	2,6-dibromophenyl	white powder	271 (d)	36.8 37.8	2.88 3.17	11.4 11.5
85	OCH_3	H	CH_3	H	2-methyl-6-methoxy-carbonylphenyl	off-white solid	212-214	52.3 52.4	4.65 4.82	14.4 14.2
86	OCH_3	H	CH_3	H	4-bromo-1-methyl-3--pyrazolyl	tan solid	263-264	35.9 36.0	3.27 3.59	21.0 20.8
87	Cl	H	CH_3	H	2-chloro-6-methoxy-phenyl	cream solid	240-243	43.4 43.6	3.12 3.38	14.5 14.7
88	OCH_3	H	OCH_3	H	2,6-dichlorophenyl	yellow powder	252-253 (d)	41.7 41.8	3.00 2.67	13.9 13.6
89	H	CH_3	H	Br	2,6-dichlorophenyl	off-white solid	240-242 (d)	35.8 35.5	2.08 1.88	12.9 13.2
90	H	CH_3	H	OCH_3	2,6-dichlorophenyl	tan solid	232	43.4 42.3	3.12 3.51	14.5 14.0
91	OCH_3	H	CH_3	H	2-bromo-6-methoxy-carbonylphenyl	off-white solid	225	42.2 42.0	3.32 3.05	12.3 12.5
92	H	CH_3	H	Br	2-fluoro-6-methoxy-carbonylphenyl	pink solid	198 (d)	40.6 40.4	2.73 2.53	12.6 12.6
93	Cl	H	CH_3	H	2-fluoro-5-methyl-3--pyridinyl	white powder	208-209	43.9 43.9	3.12 3.41	19.7 19.7
94	OCH_3	H	CH_3	H	2-fluoro-5-methyl-3--pyridinyl	white powder	237-238 (d)	47.9 47.6	4.02 3.84	19.9 19.9
95	H	Br	H	Br	2,6-dichlorophenyl	brown powder				
96	H	Br	H	OCH_3	2,6-dichlorophenyl	tan powder	>300	34.5 35.5	2.01 2.14	12.4 12.0
97	H	H	H	OCH_3	2,6-dichlorophenyl	white powder	119-121	41.8 41.5	2.70 2.42	15.0 13.9
98	OCH_3	H	H	Cl	2-fluoro-6-methoxy-carbonylphenyl	white powder	221-222	43.5 43.1	2.92 2.90	13.5 13.5

99	Cl	H	CH_3	H	4-iodo-1-methyl-3-pyrazolyl	tan solid	249-251	29.2 29.0	2.23 2.16	18.6 18.4
100	Cl	H	Cl	H	2-fluoro-6-methoxy-carbonylphenyl	lt. tan powder	182-183	40.1 39.9	2.16 2.05	13.4 13.1
101	OCH_3	H	CH_3	H	4-iodo-1-methyl-3-pyrazolyl	white solid	199 (d)	30.5 30.9	2.72 3.24	17.7 18.0
102	Cl	H	Cl	H	2-fluoro-4-methyl-3-pyridinyl	lt. tan powder	221-223	38.3 38.4	2.14 2.29	18.6 18.6
103	OCH_3	H	Cl	H	2-fluoro-4-methyl-3-pyridinyl	lt. tan powder	213-214 (d)	42.0 42.3	2.98 2.70	18.8 18.7
104	OCH_2CH_3	H	Cl	H	2-fluoro-4-methyl-3-pyridinyl	lt. tan powder	184-185 (d)	43.6 44.0	3.40 3.57	18.2 17.8
105	Cl	H	Cl	H	4-bromo-1-methyl-3-pyrazolyl	lt. tan powder	266-267 (d)	28.2 28.0	1.66 1.35	19.7 19.5
106	OCH_3	H	Cl	H	4-bromo-1-methyl-3-pyrazolyl	white powder	257-258 (d)	31.3 31.3	2.39 2.06	19.9 19.9
107	Cl	H	Cl	H	2,6-difluorophenyl	white powder	214-215	38.1 38.2	1.59 1.56	14.8 14.9
108	OCH_3	H	Cl	H	2,6-difluorophenyl	white powder	240-241 (d)	41.7 41.4	2.42 2.35	15.0 14.8
109	Cl	Br	H	OCH_3	2,6-difluorophenyl	pale pink powder	262	34.4 34.7	1.78 1.64	12.4 12.1
110	H	Br	H	OCH_3	4-bromo-1-methyl-3-pyrazolyl	brown powder	>300	28.3 32.9	2.16 2.15	18.0 15.5
111	H	Br	H	OCH_3	2-fluoro-4-methyl-3-pyridinyl	pink powder	198-200	37.5 37.4	2.66 2.36	16.8 15.3
112	H	H	Cl	H	2,6-difluorophenyl	white powder	276-278 (d)	41.8 41.7	2.05 2.30	16.3 16.3
113	H	H	Cl	H	2-fluoro-6-methoxy-carbonylphenyl	white powder	205-207	43.8 43.7	2.62 2.74	14.6 14.7
114	H	H	OCH_3	H	2,6-difluorophenyl	white powder	231-232	45.9 45.6	2.96 2.97	16.4 16.4
115	H	Cl	H	OCH_3	2,6-difluorophenyl	tan solid	223-225 (d)	41.7 41.9	2.42 2.36	15.0 14.7
116	H	Cl	H	OCH_3	2-fluoro-4-methyl-3-pyridinyl	cream solid	211	42.0 41.4	2.98 2.74	18.8 17.8
117	H	Cl	H	OCH_3	4-bromo-1-methyl-3-pyrazolyl	rust solid	225	31.3 31.4	2.39 2.07	19.9 17.5
118	OCH_3	Br	H	OCH_3	2,6-difluorophenyl	purple solid	222-223	37.4 38.9	2.37 1.83	12.5 12.8
119	Cl	H	CH_3	H	5-chloro-2-fluoro-3-pyridinyl	grey powder	225-226 (d)	38.3 38.8	2.14 1.94	18.6 18.3

120	OCH_3	H	CH_3	H	5-chloro-2-fluoro-3--pyridinyl	white powder	262-264	42.0 41.9	2.98 2.93	18.8 18.8
121	OCH_3	H	CH_3	H	1-methyl-4-(trifluoromethylthio)-3--pyrazolyl	white solid	191-193	37.0 37.3	3.10 2.91	19.9 19.8
122	Cl	H	CH_3	H	2-methoxy-6-methoxy-carbonylphenyl	purple powder	213-216	46.8 47.0	3.68 3.92	13.6 13.7
123	OCH_3	H	CH_3	H	2-methoxy-6-methoxy-carbonylphenyl	tan powder	219-221	50.2 50.0	4.46 4.67	13.8 13.7
124	Cl	H	CH_3	H	4-methyl-3-pyridinyl	white powder	223-224 (d)	46.2 46.1	3.58 3.89	20.7 20.6
125	OCH_3	H	CH_3	H	4-methyl-3-pyridinyl	lt. grey powder	209-210 (d)	50.4 49.3	4.54 4.95	21.0 19.8
126	H	CF_3	H	OCH_3	2,6-difluorophenyl	off-white solid	172-173 (d)	41.2 41.6	2.22 2.26	13.7 13.6
127	H	CF_3	H	OCH_3	2-fluoro-4-methyl-3--pyridinyl	off-white solid	238 (d)	41.5 41.6	2.74 2.67	17.3 17.1
128	H	CF_3	H	OCH_3	4-bromo-1-methyl-3--pyrazolyl	orange solid	198	31.7 32.4	2.22 2.16	18.5 18.1
129	OCH_3	H	CH_3	H	4-iodo-1-methyl-3--pyrazolyl	tan solid	201-203	36.2 36.0	2.92 2.74	18.8 19.0
130	OCH_2CH_3	H	CH_3	H	4-bromo-1-methyl-3--pyrazolyl	tan powder	245-247	37.6 37.8	3.64 3.75	20.2 19.9
131	Cl	H	H	H	2,6-difluorophenyl	tan powder	255-256 (d)	41.8 41.8	2.05 2.00	16.3 16.4
132	OCH_3	H	H	H	2,6-difluorophenyl	tan powder	255-256 (d)	45.9 46.1	2.96 2.92	16.5 16.6
133	OCH_2CH_3	H	H	H	2,6-difluorophenyl	tan powder	263-264 (d)	47.5 47.6	3.42 3.04	15.8 16.0
134	OCH_2-CH_2OCH_3	H	CH_3	H	2,6-difluorophenyl	tan powder	217-220	48.0 48.2	3.89 4.05	14.0 14.1
135	OCH_2-CH_2F	H	CH_3	H	2,6-difluorophenyl	tan powder	245-247	46.6 46.9	3.39 3.43	14.5 14.5
136	OCH_2CH_3	H	H	H	2-fluoro-4-methyl-3--pyridinyl	lt. tan powder	196-197 (d)	47.9 48.0	4.02 4.27	15.8 16.0
137	Br	H	H	H	4-bromo-1-methyl-3--pyrazolyl	tan powder	246-247 (d)	27.5 27.8	1.85 1.69	19.3 19.0
138	OCH_3	H	H	H	4-bromo-1-methyl-3--pyrazolyl	tan powder	233-234 (d)	34.1 34.2	2.86 3.03	21.7 21.6
139	OCH_2CH_3	H	H	H	4-bromo-1-methyl-3--pyrazolyl	tan powder	230-231 (d)	35.9 36.1	3.27 3.58	21.0 21.0

140	OCH_3	H	H	H	2-fluoro-4-methyl-3--pyridinyl	lt. tan powder	226-227 (d)	46.3 46.2	3.59 3.90	20.8 20.7
141	Br	H	H	H	2-fluoro-4-methyl-3--pyridinyl	brown powder	233-234 (d)	37.3 37.3	2.35 2.66	18.1 18.4
142	H	CF_3	H	F	4-bromo-1-methyl-3--pyrazolyl	orange solid	224-227 (d)	29.8 30.8	1.59 1.11	7.23 6.62
143	H	CF_3	H	F	2,6-difluorophenyl	yellow solid	136-137	39.4 39.5	1.53 1.20	14.1 13.9
144	H	CF_3	H	F	4-methyl-3-pyridinyl	tan powder	172-173	39.7 40.1	2.05 1.94	17.8 17.8
145	H	Cl	H	OCH_3	2-bromo-6-methoxy-carbonylphenyl	brown powder	173-175 (d)	37.9 38.0	2.54 2.35	11.8 11.8
146	H	Cl	H	OCH_3	2-chloro-4-methyl-3--pyridinyl	brown powder	175-176 (d)	40.2 40.0	2.86 2.73	18.0 16.2
147	H	Cl	H	OCH_3	2-chloro-4-methoxy-3--pyridinyl	brown powder	175-178 (d)	38.6 38.7	2.74 2.44	17.3 16.4
148	OCH_3	H	CH_3	H	4-methoxycarbonyl-3--pyridinyl	tan solid	181-183 (d)	47.7 47.8	4.01 4.20	18.6 18.6
149	Cl	H	CH_3	H	4-methoxycarbonyl-3--pyridinyl	tan solid	168-170	44.0 43.8	3.17 3.28	18.3 18.3
150	OCH_3	H	CH_3	H	4-carboxy-3-pyridinyl	white solid	254-256 (d)	46.3 46.0	3.61 3.31	19.3 19.0
151	OCH_3	H	CH_3	H	4-fluoro-1-methyl-3--indazolyl	tan solid	147-149 (d)	49.2 49.1	3.87 4.12	21.5 21.4
152	OCH_2-CH_2Cl	H	CH_3	H	2,6-difluorophenyl	tan powder	135-145	46.9 44.4	3.67 3.00	14.6 13.7
153	$OC_3H_{7(n)}$	H	CH_3	H	2,6-difluorophenyl	tan powder	242-245	50.3 50.3	4.22 4.35	14.7 14.5
154	H	Cl	H	OCH_3	4-iodo-1-methyl-3--pyrazolyl	brown powder	195-200 (d)	28.2 30.7	2.15 2.32	17.9 17.2
155	H	Cl	H	OCH_2CH_3	4-bromo-1-methyl-3--pyrazolyl	orange powder	192-195 (d)	33.1 33.4	2.78 2.73	19.3 18.1
156	OCH_3	H	CH_3	H	1-methyl-3-(trifluoromethyl)-4--pyrazolyl	tan solid	140-142 (d)			
157	H	Cl	H	OCH_2CH_3	2-fluoro-4-methyl-3--pyridinyl	brown powder	153-155 (d)	43.6 43.5	3.40 3.28	18.2 17.0
158	H	Cl	H	OCH_2CH_3	2,6-difluorophenyl	brown powder	168-170 (d)	41.8 41.9	2.25 2.51	13.9 14.1
159	OCH_3	H	Cl	H	4-methoxycarbonyl-3--pyridinyl	brown powder	167-172	42.3 42.3	3.04 3.14	17.6 16.5

160	OCH_3	H	CH_3	H	2-chloro-4-ethoxy-3-pyridinyl	white solid	215-216	45.3 45.3	4.05 3.76	17.6 17.6
161	$OC_3H_{7(n)}$	H	Cl	H	2-chloro-4-ethoxy-3-pyridinyl	tan solid	203-204	47.9 48.0	4.73 5.06	16.4 16.2
162	H	H	H	Cl	2,6-difluorophenyl	white powder	263-265	41.8 41.6	2.05 2.14	16.3 16.2
163	H	H	H	Cl	4-bromo-1-methyl-3-pyrazolyl	white powder	272-273 (d)	30.7 30.4	2.06 2.06	21.5 21.1
164	H	H	H	Cl	2-fluoro-4-methyl-3-pyridinyl	yellow powder	213-216	42.2 41.9	2.65 2.99	20.5 20.4
165	H	H	H	OCH_3	2,6-difluorophenyl	white powder	254-255	45.9 45.9	2.96 2.55	16.5 16.4
166	H	H	H	OCH_3	4-bromo-1-methyl-3-pyrazolyl	off-white powder	214-216 (d)	34.1 34.0	2.86 3.04	21.7 21.5
167	H	H	H	OCH_3	2-fluoro-4-methyl-3-pyridinyl	white powder	204-206	46.3 43.8	3.59 3.17	20.8 19.1
168	OCH_3	H	Cl	H	4-iodo-1-methyl-3-pyrazolyl	white powder	222-226 (d)	28.2 28.6	2.15 2.14	17.9 18.1
169	OCH_3	H	Cl	H	2-chloro-4-methyl-3-pyridinyl	tan powder	197-199	40.2 40.9	2.86 2.65	18.0 16.2
170	OCH_3	H	Cl	H	2-chloro-4-methoxy-3-pyridinyl	white powder	212-214 (d)	38.6 39.6	2.74 3.35	17.3 15.1
171	OCH_3	H	Cl	H	2-methyl-6-methoxy-carbonylphenyl	white powder	190-192	46.8 46.7	3.68 3.98	13.6 13.5
172	H	Cl	H	$OC_3H_{7(n)}$	4-bromo-1-methyl-3-pyrazolyl	yellow solid	185-187	34.7 34.9	3.14 3.31	18.7 18.1
173	H	Cl	H	$OC_3H_{7(n)}$	2-fluoro-4-methyl-3-pyridinyl	off-white solid	203-204	45.1 45.3	3.78 3.60	17.5 17.1
174	Cl	H	CH_3	H	2-fluoro-4-ethyl-3-pyridinyl	white solid	223-225	45.5 45.5	3.54 3.37	18.9 18.6
175	Cl	H	CH_3	H	4-bromo-1-methyl-3-pyrazolyl	tan powder	240-242 (d)	33.1 33.8	2.78 3.04	19.3 18.9
176	Cl	H	CH_3	H	2,6-difluorophenyl	tan powder	234-236 (d)	42.2 42.3	3.07 2.85	13.8 14.4
177	$OC_3H_{7(n)}$	H	Cl	H	2,6-difluorophenyl	white powder	199-200 (d)	44.7 44.7	3.25 3.24	13.9 13.6
178	OCH_3	H	CH_3	H	2-fluoro-4-ethyl-3-pyridinyl	white powder	221-222 (d)	49.3 49.5	4.41 4.23	19.2 19.1
179	H	Cl	H	$OC_3H_{7(n)}$	2,6-difluorophenyl	yellow solid	168-170	44.7 44.8	3.25 3.25	13.9 13.5
180	H	Cl	H	$OC_3H_{7(n)}$	2-fluoro-4-methyl-3-pyridinyl	yellow solid	228-230 (d)	45.1 45.1	3.78 3.76	17.2 16.6

181	H	Cl	H	$OC_3H_7(i)$	4-bromo-1-methyl-3-pyrazolyl	white solid	209-210	34.7 34.5	3.14 3.02	18.7 18.6
182	H	CH_3	H	H	2,6-difluorophenyl	yellow powder	229-233 (d)	48.2 49.3	3.11 3.23	17.8 17.1
183	H	H	H	CH_3	2,6-difluorophenyl	yellow powder	221-223 (d)	48.2 48.5	3.11 3.13	17.3 16.8
184	Cl	H	CH_3	H	2-chloro-4-propoxy-3-pyridinyl	colorless solid	205-206 (d)	43.3 43.2	3.63 3.75	16.8 16.6
185	OCH_3	H	CH_3	H	2-chloro-4-(1-methyl-ethoxy-3-pyridinyl	tan solid	243-245 (d)	43.3 43.1	3.63 3.50	16.8 16.5
186	OCH_3	H	CH_3	H	2-chloro-4-propoxy-3-pyridinyl	colorless solid	206-207 (d)	46.7 47.0	4.41 4.46	17.0 17.2
187	OCH_3	H	CH_3	H	2-chloro-4-(1-methyl-ethoxy-3-pyridinyl	white solid	236-237 (d)	46.7 46.0	4.41 4.33	17.0 16.7
188	OCH_3	H	Cl	H	4-bromo-1-methyl-5-pyrazolyl	tan powder	119 (d)	31.3 33.1	2.39 3.14	19.9 17.4
189	$OC_3H_7(i)$	H	CH_3	H	2,6-difluorophenyl	white powder	235-237	50.3 50.4	4.22 4.03	14.7 14.8
190	OCH_3	H	Cl	H	2-chloro-6-methoxy-carbonylphenyl	white powder	211-214	41.8 39.6	2.80 2.44	12.0 11.8
191	OCH_3	H	H	Cl	2,6-difluorophenyl	lt. grey powder	>300	41.7 41.7	2.42 2.58	15.0 15.1
192	OCH_3	H	H	Br	4-bromo-1-methyl-3-pyrazolyl	lt. tan powder	>300	31.3 31.8	2.39 2.44	19.9 19.8
193	OCH_3	H	H	Br	2-fluoro-4-methyl-3-pyridinyl	lt. tan powder	>300	42.0 42.1	2.98 3.19	18.8 18.9
194	OCH_3	H	CH_3	H	4-chloro-1-methyl-3-pyrazolyl	tan solid	235-237	40.4 40.2	3.67 3.75	23.6 23.7
195	OCH_3	H	CH_3	H	5-chloro-1-methyl-4-pyrazolyl	tan solid	207-209	40.4 40.2	3.67 4.08	23.6 23.5
196	OCH_2CH_2F	H	CH_3	H	4-bromo-1-methyl-3-pyrazolyl	tan powder	244-246 (d)	36.0 36.7	3.26 3.15	19.4 18.9
197	$OCH_2CH_2OCH_3$	H	Cl	H	2,6-difluorophenyl	tan powder	210-212 (d)	43.0 43.1	3.13 3.27	13.4 13.1
198	OCH_3	H	Br	H	2,6-difluorophenyl	lt. tan powder	235-236 (d)	37.2 37.2	2.16 2.18	13.4 13.4
199	OCH_3	H	Br	H	2-fluoro-4-methyl-3-pyridinyl	lt. tan powder	210-211 (d)	37.5 37.7	2.66 2.54	16.8 16.6
200	OCH_3	H	Br	H	4-bromo-1-methyl-3-pyrazolyl	lt. tan powder	241-242 (d)	28.3 28.7	2.16 2.25	18.0 18.3
201	OCH_3	H	H	Br	2,6-difluorophenyl	off-white powder	>300	37.2 36.8	2.16 2.12	13.4 13.3

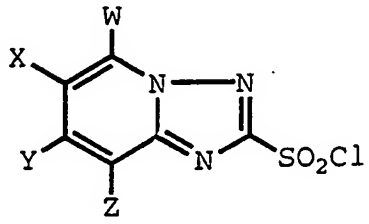
202	OCH_3	H	H	Br	2-fluoro-4-methyl-3-pyridinyl	tan powder	>300	37.5 36.9	2.66 2.50	16.8 16.5
203	OCH_3	H	H	Br	4-bromo-1-methyl-3-pyrazolyl	off-white powder	>300	28.3 28.5	2.16 2.13	18.0 17.9
204	OCH_3	H	CH_3	H	2,4,5-trichloro-3-pyridinyl	colorless solid	235-236 (d)	36.9 37.0	2.38 2.49	16.6 16.5
205	OCH_2CH_3	H	CH_3	H	2-chloro-4-ethoxy-3-pyridinyl	colorless solid	200-201	46.7 46.7	4.41 4.18	17.0 16.9
206	OCH_2CH_3	H	CH_3	H	2-chloro-4-methoxy-3-pyridinyl	white solid	239-240 (d)	45.3 45.1	4.05 4.13	17.6 17.4
207	Cl	H	CH_3	H	2-chloro-4-methoxy-carbonyl-3-pyridinyl	white powder	250-251 (d)	38.6 40.0	2.74 2.66	17.3 16.3
208	$OC_3H_7(i)$	H	CH_3	H	2-chloro-4-methoxy-3-pyridinyl	white powder	244-245 (d)	46.7 46.2	4.41 4.11	17.0 16.9
209	OCH_2CF_3	H	CH_3	H	2-chloro-4-methoxy-3-pyridinyl	white solid	222-224 (d)	39.9 39.6	2.90 2.53	15.5 15.1
210	OCH_2CH_3	H	CH_3	H	2-chloro-4-(1-methyl-ethoxy)-3-pyridinyl	white solid	217-218 (d)	47.9 47.6	4.73 4.69	16.4 16.3
211	OCH_2CH_3	H	CH_3	H	4-ethoxycarbonyl-3-pyridinyl	white powder	191-192 (d)	50.4 50.8	4.46 4.72	17.4 17.3
212	OCH_3	H	CH_3	H	2-chloro-4-methoxy-carbonyl-3-pyridinyl	white powder	230-231 (d)	43.8 44.0	3.43 3.46	17.0 16.8
213	OCH_2CH_3	H	Cl	H	2-chloro-4-methyl-3-pyridinyl	lt. brown powder	229-230 (d)			
214	OCH_3	H	Cl	H	2-chloro-4-ethoxy-3-pyridinyl	lt. brown powder	161-162 (d)			
215	OCH_2CH_3	H	Cl	H	2-chloro-4-ethoxy-3-pyridinyl	lt. brown powder	203-204 (d)			
216	OCH_2CH_3	H	Cl	H	2-chloro-4-methoxy-3-pyridinyl	lt. brown powder	224-225 (d)	40.2 40.6	3.13 3.26	16.4 16.6
217	OCH_3	H	CH_3	H	2-methoxy-4-methyl-3-pyridinyl	white powder	235-237 (d)	49.6 49.5	4.72 4.57	19.3 19.0
218	$OC_3H_7(i)$	H	Cl	H	2-chloro-4-methyl-3-pyridinyl	tan solid	226-227 (d)	43.3 43.1	3.63 3.70	16.8 16.2
219	$OC_3H_7(i)$	H	Cl	H	2-chloro-4-methoxy-3-pyridinyl	off-white solid	154-155 (d)	41.7 41.4	3.50 3.26	16.2 15.7
220	H	CF_3	H	OCH_3	2-chloro-4-methoxy-3-pyridinyl	off-white solid	225-227	38.4 38.6	2.53 2.20	16.0 16.1
221	H	CF_3	H	OCH_2CH_3	2-chloro-4-methoxy-3-pyridinyl	off-white solid	162-163	39.9 37.5	2.90 3.22	15.5 14.7
222	Cl	H	CH_3	H	2-methoxy-4-methyl-3-pyridinyl	off-white solid	221-222	45.7 45.3	3.84 3.95	19.0 19.2

223	OCH_3	H	H	Cl	2-chloro-4-methoxy-3--pyridinyl	off-white solid	>300 (d)	38.6 38.4	2.74 2.75	17.3 17.1
224	OC_3H_7(n)	H	H	Cl	2-chloro-4-methoxy-3--pyridinyl	off-white powder	168-170 (d)	41.7 41.8	3.50 3.55	16.2 16.0
225	OC_2H_5	H	H	Cl	2-chloro-4-methoxy-3--pyridinyl	off-white powder	231-233 (d)	40.1 40.3	3.42 3.31	16.8 16.3
226	OCH_3	H	CH_3	H	2-fluoro-4-methoxy-3--pyridinyl	white solid	257-258 (d)	45.8 45.8	3.84 3.87	19.1 19.0
227	OC_2H_5	H	CH_3	H	2-fluoro-4-methoxy-3--pyridinyl	white solid	240-241 (d)	47.2 46.7	4.23 4.55	18.4 18.1
228	OCH_3	H	H	Br	2-chloro-4-methoxy-3--pyridinyl	tan solid	220-222 (d)	34.8 34.9	2.47 2.47	15.6 15.5
229	OCH_3	H	H	Br	4-methoxycarbonyl-3--pyridinyl	tan powder	154-156 (d)	38.0 38.2	2.73 2.79	15.8 15.6
230	OCH_3	H	CH_3	H	2-chloro-4-(2,2,2--trifluoroethoxy)-3--pyridinyl	white solid	213-214	39.9 38.9	2.90 3.12	15.5 15.2
231	OC_2H_5	H	CH_3	H	2-chloro-4-(2,2,2--trifluoroethoxy)-3--pyridinyl	white solid	211-212	41.3 41.1	3.25 3.30	15.0 15.0
232	OCH_3	H	CH_3	H	2-bromo-4-methoxy-3--pyridinyl	white solid	214-215 (d)	39.3 39.0	3.30 3.46	16.4 16.0
233	OC_2H_5	H	CH_3	H	2-bromo-4-methoxy-3--pyridinyl	off-white solid	245-246 (d)	40.7 40.9	3.65 3.85	15.8 15.9
234	H	CH_3	H	OCH_3	2-chloro-4-methoxy-3--pyridinyl	tan powder	198-200	43.8 43.0	3.68 3.76	18.3 17.9
235	OCH_3	H	CH_3	H	2-fluoro-4-ethoxy-3--pyridinyl	white solid	253-255	47.2 47.3	4.23 4.00	18.4 18.5
236	OC_2H_5	H	CH_3	H	2-fluoro-4-ethoxy-3--pyridinyl	tan solid	206-208	48.6 48.7	4.59 4.72	17.7 17.9
237	Cl	H	CH_3	H	2-fluoro-4-ethoxy-3--pyridinyl	white solid	218-219	43.6 43.6	3.40 3.38	18.2 18.4
238	OC_2H_5	H	CH_3	H	2-chloro-4-(n)propoxy--3-pyridinyl	white solid	130-132	47.9 47.6	4.73 4.67	16.4 16.4
239	OCH_3	H	CH_3	H	2-chloro-4-(2-fluoro-ethoxy)-3-pyridinyl	off-white solid	218-220 (d)	43.3 43.1	3.64 3.60	16.8 16.7
240	OC_2H_5	H	CH_3	H	2-chloro-4-(2-fluoro-ethoxy)-3-pyridinyl	white solid	210-212 (d)	44.7 44.5	3.99 4.19	16.3 16.6
241	OC_2H_5	H	H	Cl	2,6-difluorophenyl	white powder hydrate	300 (d)	41.3 41.3	3.22 2.65	13.8 13.6

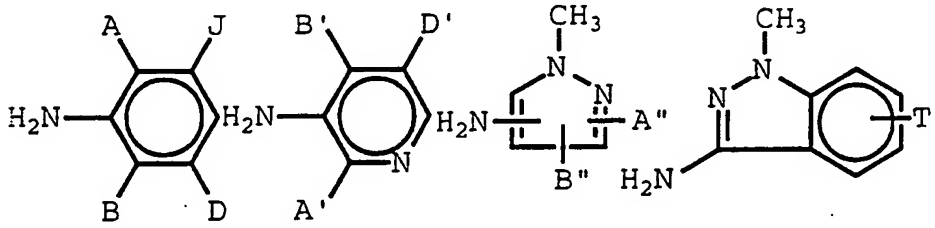
242	OCH_3	H	H	Br	2-chloro-6-methoxy-carbonylphenyl	tan powder	202-204 (d)	37.9 37.8	2.54 2.56	11.8 11.6
243	OCH_3	H	CH_3	H	4-bromo-1-methyl-3-pyrazolyl	white powder	234-236	35.9 35.1	3.27 3.24	21.0 21.4
244	OCH_3	H	CH_3	H	1-methyl-4-(trifluoromethyl)-3-pyrazolyl	tan solid	240-242	40.0 40.2	3.36 3.14	21.5 21.4
245	Cl	H	CH_3	H	1-methyl-3-(trifluoromethyl)-5-methoxy-4-pyrazolyl	tan solid	211-212	36.8 36.8	2.85 2.74	19.8 19.8
246	OCH_3	H	CH_3	H	1-methyl-3-(trifluoromethyl)-5-methoxy-4-pyrazolyl	off-white solid	186-188	40.0 38.8	3.60 3.52	20.0 19.4
247	OC_2H_5	H	CH_3	H	1-methyl-3-(trifluoromethyl)-5-methoxy-4-pyrazolyl	brown solid	205-207	41.5 40.5	3.94 3.52	19.4 19.1
248	OCH_3	H	CH_3	H	1,3-dimethyl-5-(trifluoromethyl)-4-pyrazolyl	off-white solid	247-249	41.6 41.1	3.74 4.07	20.8 20.6
249	OC_2H_5	H	CH_3	H	1,3-dimethyl-5-(trifluoromethyl)-4-pyrazolyl	tan solid	251-252	43.1 43.4	4.10 4.16	20.1 20.3
250	OCH_3	H	CH_3	H	1-methyl-3-(trifluoromethyl)-5-chloro-4-pyrazolyl	off-white solid	226-228	36.8 36.9	2.85 3.04	19.8 19.5
251	OC_2H_5	H	CH_3	H	1-methyl-3-(trifluoromethyl)-5-chloro-4-pyrazolyl	white solid	239-240	38.3 38.6	3.22 3.46	19.2 19.2
252	Cl	H	H	OCH_3	2,6-difluorophenyl	off-white powder	190-191 (d)	41.7 41.3	2.42 2.37	15.0 15.0
253	Cl	H	H	OCH_3	2-chloro-4-methoxy-3-pyridinyl	white powder	253-254 (d)	38.6 38.8	2.74 2.90	17.3 17.4
254	Cl	H	H	OCH_3	1-methyl-4-bromo-3-pyrazoyl	lt. tan powder	269-270 (d)	31.3 31.9	2.39 2.39	19.9 19.6
255	OCH_3	H	H	OCH_3	2,6-difluorophenyl	off-white powder	319-320 (d)	45.1 43.4	3.27 3.13	15.1 14.8
256	OCH_3	H	H	OCH_3	2-chloro-4-methoxy-3-pyridinyl	lt. tan powder	256-258 (d)	42.1 41.7	3.53 2.85	17.7 17.3
257	OCH_3	H	H	OCH_3	1-methyl-4-bromo-3-pyrazoyl	tan powder	257-258 (d)	34.5 34.1	3.14 2.98	20.1 19.8
258	OC_2H_5	H	CH_3	H	1,5-dimethyl-3-(ethoxycarbonyl)-4-pyrazolyl					

259	OCH_3	H	F	H	4-bromo-1-methyl-3-pyrazolyl						
260	OCH_3	H	CF_3	H	2,6-difluorophenyl						
261	H	F	H	OCH_3	2,6-difluorophenyl						
262	OCH_3	H	H	F	2,6-difluorophenyl						
263	OCH_3	H	H	I	4-bromo-1-methyl-3-pyrazolyl						

The compounds of Formula I wherein V represents hydrogen can generally be prepared by combining a 2-chlorosulfonyl[1,2,4]triazolo-[1,5-a]pyridine compound of Formula II:



with an appropriately substituted aromatic primary amine compound of Formula III:



in the presence of pyridine or a methylpyridine compound, and, optionally but preferably, a catalytic amount of dimethyl sulfoxide. The substituents W, X, Y, and Z of Formula II and the substituents A, B, J, D, A', B', D', A", B", and T are as defined hereinbefore for the compounds of Formula I. Compounds of Formula II wherein one or both of W and Z represents Cl or OCH_3 or wherein W represents OCH_2CH_3 or $OC_3H_7(i)$ are often preferred as are compounds of Formula II wherein two of W, X, Y, and Z represent hydrogen.

The preparation is usually accomplished by placing a 2-chlorosulfonyl[1,2,4]triazolo[1,5-a]pyridine compound of Formula II, an aromatic amine compound of Formula III, and an inert solvent, such as acetonitrile, N,N-dimethylformamide, N-methyl-2-pyrrolidinone, or tetrahydrofuran, in a vessel and then adding the pyridine or methylpyridine, preferably pyridine, and a catalytic amount of dimethyl sulfoxide. The mixture is allowed to react, typically at ambient temperature, but heating if necessary. After a substantial quantity of the compound of Formula I has formed or a substantial quantity of the chlorosulfonyl compound of Formula II has been consumed, the desired product is recovered, typically by removing the solvent by evaporation, adding water, and removing the liquids from the solid that forms by centrifugation or filtration. The

recovered product can be purified, if desired, by extracting with an immiscible organic solvent, such as methylene chloride, and with water. Alternatively, the desired compounds of Formula I can be purified by recrystallization and by other commonly used methods.

Approximately equimolar quantities of the compounds of Formulas II and III are generally used in the preparation of compounds of Formula I although a substantial excess of one or the other may be employed. The pyridine compound is generally employed in an amount of from at least 1 to 5 moles per mole of compound of Formula II. Dimethyl sulfoxide is typically used in less than an equimolar amount; amounts over 0.3 mole per mole of compound of Formula II are usually deleterious. Acetonitrile is often the preferred solvent.

It is sometimes advantageous to prepare the compounds of Formula I by condensing a compound of Formula II with an N-trialkylsilyl derivative of a substituted aromatic amine compound of Formula III. The method employed is analogous to that described in U.S. Patent 4,910,306 for N-trialkylsilylanilines. The reaction conditions required are essentially the same as those described hereinabove for the condensation of a chlorosulfonyl compound of Formula II with a substituted aromatic amine of Formula III with the exception that the pyridine compound base may be omitted. The substituted N-trialkylsilyl derivatives of aromatic amines employed can be prepared from the corresponding substituted aromatic amine compounds by treatment with a trialkylsilyl halide and a trialkylamine essentially as described in U.S. Patent 4,910,306 for aniline compounds. Sodium iodide is typically employed as a catalyst when the halide is chloride. The N-trialkylsilyl compounds are typically prepared and used immediately and without purification.

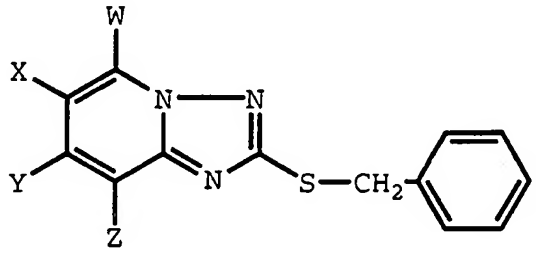
Compounds of Formula I wherein V represents hydrogen and W, Y, or Z represents OCH_2CF_3, $S(C_1\text{-}C_3)$alkyl, or $O(C_1\text{-}C_3)$alkyl optionally mono-substituted with F, Cl, or OCH_3 can be made from the corresponding compounds of Formula I wherein W, Y, or Z represents F, Cl, or Br by treatment with an appropriate nucleophilic reagent, such as sodium methoxide or sodium methanethiolate in methanol, acetonitrile, or dimethyl sulfoxide. Similarly, such compounds wherein W, Y, or Z represents F or Br can sometimes be made from corresponding compounds wherein W, Y, or Z represents Cl by treatment with an alkali metal halide, such as potassium fluoride. Typically, chloro compounds are the most readily available and are employed. The reaction conditions employed are similar to those used

for the related exchange reactions of 2- and 4-halopyrimidines and pyridines. Non-aqueous media are preferred. The amount of heat and the time required are dependent on the position of the halogen, the identity of the halogen, the other substituents present, and the medium employed. The selective replacement of a halogen in the W position can readily be achieved as this halogen is much more reactive than are halogens in the X, Y, and Z positions. Halogens in the Z position are more reactive than those in the X position.

Many compounds of Formula I wherein one or more of X and Z represents F, Cl, Br, or H can be also be prepared by first preparing a compound of Formula I wherein one or both of X and Z represents nitro, reducing the nitro group to an amino group using standard reaction procedures for the reduction of a nitro group to an amino group well-known to those in the art, and then converting the amino group to a F, Cl, Br, I, OH, or H group by diazotization under appropriate reaction conditions generally known in the art.

Compounds of Formula I wherein V represents COR', $CO_2R"$, or $CONR"'_2$ wherein R', R", and R"' are as defined hereinabove can be prepared from compounds of Formula I wherein V represents hydrogen by acylation with a compound of the formula ClCOR', $ClCO_2R"$, or $ClCONR"'_2$ using conventional procedures known in the art for the acylation of sulfonamides.

The 2-chlorosulfonyl[1,2,4]triazolo[1,5-a]pyridine compounds of Formula II can be prepared by chloroxidation of 2-benzylthio[1,2,4]triazolo[1,5-a]pyridine compounds of Formula IV:



wherein W, X, Y, and Z are as defined hereinabove. Such compounds wherein one or both of W and Z represents Cl or OCH_3 or wherein W represents OCH_2CH_3 or $OC_3H_7(i)$ are often preferred as are compounds wherein two of W, X, Y, and Z represent hydrogen. The chloroxidation reaction can be carried out under the reaction conditions usually employed for such reactions. In a typical operation, the compound of Formula IV is dissolved or suspended in a water-immiscible organic solvent, such as chloroform or dichloro-

methane, water is added, and chlorine is added with good agitation to the mixture at temperatures below about 20°C. When the reaction is complete, the organic solvent phase is separated and washed with water and the solvent is typically removed by evaporation to obtain the desired chlorosulfonyl compound as a crude product. This crude product can be purified by standard methods, such as by recrystallization, extraction, or chromatography.

Compounds of Formula IV wherein W, Y, or Z represents I, F, OCH_2CF_3, $S(C_1-C_3)$alkyl, or $O(C_1-C_3)$alkyl optionally monosubstituted with F, Cl, or OCH_3 can be made from the corresponding compounds of Formula IV wherein W, Y, or Z represents F, Cl, or Br by treatment with an appropriate nucleophilic reagent, such as sodium methoxide or sodium methanethiolate in methanol or potassium ethoxide in ethanol, acetonitrile, or dimethyl sulfoxide. The reaction conditions are similar to those employed to make the corresponding conversion of compounds of Formula I wherein W, Y, or Z represents F, Cl, or Br to analogs wherein W, Y, or Z represents OCH_2CF_3, $S(C_1-C_3)$alkyl or $O(C_1-C_3)$alkyl optionally monosubstituted with F, Cl, or OCH_3. Heat is applied, if necessary, to accelerate the reaction. Compounds of Formula IV wherein W represents F, OCH_2CF_3, $S(C_1-C_3)$alkyl or $O(C_1-C_3)$alkyl optionally monosubstituted with F, Cl, or OCH_3 and one or more of X, Y, and Z represents Cl or Br can be made in this way from compounds wherein W and one or more of X, Y, and Z represents chloro or bromo by the selective reaction of the chloro or bromo substituent in the 5-position (W) because it is considerably more easily displaced. Similarly, compounds of Formula IV wherein Z represents F, OCH_2CF_3, $S(C_1-C_3)$alkyl or $O(C_1-C_3)$alkyl optionally monosubstituted with F, Cl, or OCH_3 and X represents chloro or bromo can be made from compounds wherein both X and Z represent chloro or bromo by selective reaction.

Compounds of Formula IV wherein W represents Cl can be prepared in three steps from a substituted glutaconic anhydride. The anhydride is first treated with the reaction product of thiosemicarbazide and benzyl chloride in the presence of a tertiary amine, such as triethylamine, and in a solvent, such as 2-propanol. The reaction can be carried out by heating the reaction mixture described for a period, adding an alkali metal alkoxide, such as sodium methoxide and heating for another period, and then acidifying the reaction mixture and recovering the insoluble solid product that forms. This solid product can then converted to a compound of Formula IV wherein W represents OH by carefully heating until the evolution of

carbon dioxide ceases. This compound of Formula I wherein W represents OH can then be converted to the corresponding compound wherein W represents Cl by combining it with an excess of phosphorus oxychloride and a tertiary amine, such as N,N-dimethylaniline, and heating. The product can then be recovered by removing the excess phosphorus oxychloride by evaporation under reduced pressure.

Compounds of Formula IV wherein one or both of X and Z represents F, Cl, Br, I, OH, or H can also be prepared by first preparing a compound of Formula IV wherein one or both of X and Z represents nitro, reducing the nitro group to an amino group using standard reaction procedures for the reduction of a nitro group to an amino group well-known to those in the art, and then converting the amino group to a F, Cl, Br, I, OH, or H group by diazotization under appropriate reaction conditions. Compounds wherein one of X and Z represents OR can be prepared from the corresponding compound wherein one of X and Z represents OH by consecutive treatment with phosphorus oxychloride and an alkali metal salt of the alcohol ROH. Compounds wherein W and/or Y represents chloro or bromo can be obtained by halogenation of the amino compounds before diazotization. Appropriate reaction conditions for such reactions are generally known in the art.

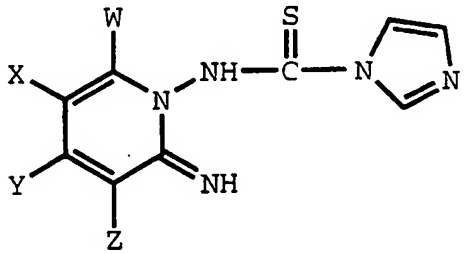
It has been found, however, that the reduction of a compound of Formula IV wherein W and X represent hydrogen, Y represents hydrogen, methyl, or a halogen, and Z represents nitro (2-benzylthio-8-nitro[1,2,4]-triazolo[1,5-a]pyridine and certain 7-substituted analogs) with stannous chloride in the presence of stannic chloride and a reactive medium comprising hydrogen chloride or a C_1-C_3 alcohol produces not only the corresponding compound of Formula IV wherein Z represents amino, but also the corresponding compound of Formula IV wherein W represents chloro or alkoxy and Z represents amino. The latter can be made to be the dominate product. The amino compounds obtained can be converted into compounds of Formula IV wherein W represents chloro or alkoxy and Z represents hydrogen or a halogen by standard means.

When the reactive medium contains hydrogen chloride as an essential ingredient, an 8-amino-2-benzylthio-5-chloro[1,2,4]triazolo[1,5-a]-pyridine compound is obtained along with a small amount of an 8-amino-2--benzylthio[1,2,4]triazolo[1,5-a]pyridine compound. The reactive medium generally includes a solvent, which can be water, N-methyl-2-pyrrolidinone, N,N-dimethylformamide, dimethyl sulfoxide, tetrahydrofuran, or other

suitable solvent. Concentrated aqueous hydrochloric acid is the generally preferred reactive medium in this embodiment. When the reactive medium contains an alcohol as an essential ingredient, a 5-alkoxy-8-amino-2--benzylthio[1,2,4]triazolo[1,5-a]pyridine compound is obtained. Methanol, ethanol, and propanol are examples of suitable alcohols. The reaction is generally carried out by combining one molar equivalent of a 2-benzylthio--8-nitro[1,2,4]triazolo[1,5-a]pyridine compound with at least 3 molar equivalents of stannous chloride, one molar equivalent of stannic chloride, and an excess of hydrogen chloride or at least one molar equivalent of the alcohol. The alcohols are typically employed in a large excess. The reaction mixture is heated at 50 to 120°C with good agitation to effect the simultaneous reduction and substitution. The products can be recovered by standard means, including by dissolving the hydrochloride that is formed initially in water, basifying with an alkali metal hydroxide, and recovering the product by filtration or by solvent extraction.

Compounds of Formula IV wherein one or both of X and Z represents nitro can be prepared from (3 or 5)-nitro-2-hydrazinopyridine compounds by consecutive reactions with carbon disulfide, hydrogen peroxide, and benzyl chloride and triethylamine. The reactions take place at ambient temperatures and are exothermic. A reaction period of up to several days is sometimes required to assure that all of the product is in the desired, rearranged state, but rearrangement takes place spontaneously under the reaction conditions. The method is similar to that disclosed in the art for the preparation of 2-benzylthio[1,2,4]triazolo[1,5-c]pyrimidine compounds.

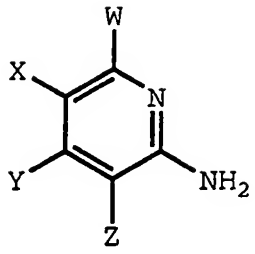
Many compounds of Formula IV can be prepared by the reaction 1-((1-imidazolylthionyl)amino)-2-iminopyridine compounds of Formula V:



with benzyl chloride in a solvent, such as butanol, by heating. The desired compounds of Formula V can be recovered by conventional means.

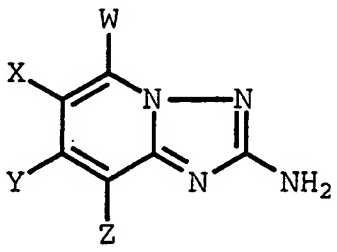
Compounds of Formula V can be prepared by combining O-mesitylenesulfonylacetohydroxamate and perchloric acid in dioxane at

temperatures below ambient, adding the solution obtained to 2-aminopyridine compounds of Formula VI:



at temperatures below ambient, and then adding 1,1'-thiocarbonyldiimidazole to the mixture. The desired compounds of Formula VI can be recovered by conventional means.

It has additionally been found that compounds of Formula IV can be prepared from the corresponding 2-amino[1,2,4]triazolo[1,5-a]pyridine of Formula VII:



wherein W, X, Y, and Z are as defined for compounds of Formula I. Compounds of Formula VII wherein one or both of W and Z represents Cl or OCH_3 or wherein W represents OCH_2CH_3 or $OC_3H_7(i)$ are often preferred as are compounds of Formula II wherein two of W, X, Y, and Z represent hydrogen. The method is closely related to the chemistry disclosed in J. Chemical Society Chemical Communications, 1980 756-757. It is especially useful for the preparation of compounds of Formula I wherein W represents chloro, methoxy, ethoxy, or isopropoxy, X and Z each represent hydrogen, and Y represents methyl or a halogen; or wherein W represents chloro, methoxy or ethoxy, X and Y each represent hydrogen, and Z represents methyl, methoxy, or a halogen; or wherein Z represents chloro, methoxy or ethoxy, X and Y each represent hydrogen, and X represents methyl, trifluoromethyl, or a halogen. The preparation is preferably carried out by adding an excess of t-butyl nitrite to a solution consisting of a compound of Formula VII and dibenzyl disulfide in a compatible organic solvent, such as acetonitrile, and heating the combination to reflux until the evolution of gas subsides. The reaction is exothermic. The desired compounds of Formula IV can be

recovered by conventional means, such as by removing the volatile components of the product mixture by evaporation, and can be purified by conventional means, such as by column chromatography or recrystallization.

Compounds of Formula VII can be prepared by treatment of appropriately substituted N-(2-pyridinyl)-N-carboethoxythiourea compounds with hydroxylamine in a solvent such as ethanol and heating for a few hours. The hydroxylamine is typically generated by neutralization of the hydrochloride with a hindered tertiary amine, such as diisopropylethylamine, or an alkoxide, such as sodium ethoxide. The desired compounds of Formula VII can be recovered by conventional means, such as by removal of the volatile components of the reaction mixture by evaporation, and can be purified by conventional means, such as by extraction with water and/or other solvents in which they are sparingly soluble. N-(2-Pyridinyl)-N--carboethoxythiourea compounds can be obtained by treatment of appropriately substituted 2-aminopyridine compounds with ethoxycarbonyl isothiocyanate. Compounds of Formula VII can also be prepared from 2-cyanoaminopyridine compounds by the methods disclosed in Monatshefte fur Chemie, 114, 789-798 (1983).

The substituted anilines and 3-, 4-, and 5-aminopyrazoles that are required as intermediates for the compounds of Formula I are known in the art or can be prepared by general methods known in the art. The substituted 3-aminopyridines and 3-aminoindazoles that are required as intermediates can be prepared by the methods presented herein, are known in the art, or can be prepared by general methods known in the art.

4-Alkoxy-3-amino-2-chloropyridine compounds can be prepared by chlorination of known 4-alkoxy-3-aminopyridine compounds. 4-Alkoxy-3--amino-2-fluoropyridine compounds can be prepared from 4-alkoxy-2-fluoropyridine compounds by lithiation with butyl lithium and treatment of the intermediate with diphenyl phosphoryl azide. 4-Alkoxy-2-fluoropyridine compounds can be prepared by reduction of 4-Alkoxy-3,5-dichloro-2-fluoropyridine compounds with hydrogen. Many 4-substituted 2-alkoxy-3-aminopyridine compounds can be prepared from 2-alkoxy-3-aminopyridine compounds by lithiation of the corresponding t-butoxycarbonyl derivative and reaction of this with an electrophilic reagent in processes closely related to those disclosed in J. Organic Chemistry, 60, 1875-1877 (1995). Thus, 2-alkoxy-3--amino-4-fluoropyridine compounds can be prepared from t-butyl N-(2-alkoxy--3-pyridinyl)carbamates by fluorination with N-fluorodibenzenesulfonimide of the intermediate obtained on lithiation with t-butyl lithium followed by

treatment with anhydrous p-toluenesulfonic acid to remove the protecting t-butoxycarbonyl group. Similarly, 2-alkoxy-3-amino-4-chloropyridine compounds can be obtained by chlorination of t-butyl N-(2-alkoxy-3--pyridinyl)carbamates with hexachloroethane in an analogous process. Alkyl 3-amino-2-alkoxyisonicotinate compounds can be prepared analogously from t-butyl N-(2-alkoxy-3-pyridinyl)carbamate compounds by lithiating with butyl lithium, treating the intermediate formed with carbon dioxide and then an alkyl iodide, and finally removing the protecting t-butoxycarbonyl group by treatment with anhydrous p-toluenesulfonic acid. The amine-protected t-butyl N-(2-alkoxy-3-pyridinyl)carbamate compounds can be prepared from 2-alkoxy-3-aminopyridine compounds by treatment with di-t-butyl dicarbonate. 3-Amino-2-chloroisonicotinic acid esters can be prepared by chlorination of 3-aminoisonicotinic acid esters using 1,3-dichloro-5,5-dimethylhydantion as the chlorinating agent. 3-Amino-2--fluoro-4-methylpyridine can be prepared by palladium on carbon catalyzed reduction of 2-fluoro-4-methyl-3-nitropyridine with hydrogen. This compound can be converted to other 4-alkyl-3-amino-2-fluoropyridine compounds by alkylation of the methyl group. These and other 3-amino-pyridine compounds of Formula III can be made using a variety of preparative methods well-established in the art.

While it is possible to utilize the 1,2,4-triazolo[1,5-a]-pyridine-2-sulfonamide compounds of Formula I directly as herbicides, it is preferable to use them in mixtures containing an herbicidally effective amount of the compound along with at least one agriculturally acceptable adjuvant or carrier. Suitable adjuvants or carriers should not be phytotoxic to valuable crops, particularly at the concentrations employed in applying the compositions for selective weed control in the presence of crops, and should not react chemically with the compounds of Formula I or other composition ingredients. Such mixtures can be designed for application directly to weeds or their locus or can be concentrates or formulations which are normally diluted with additional carriers and adjuvants before application. They can be solids, such as, for example, dusts, granules, water dispersible granules, or wettable powders, or liquids, such as, for example, emulsifiable concentrates, solutions, emulsions or suspensions.

Suitable agricultural adjuvants and carriers that are useful in preparing the herbicidal mixtures of the invention are well known to those skilled in the art.

Liquid carriers that can be employed include water, toluene, xylene, petroleum naphtha, crop oil, acetone, methyl ethyl ketone, cyclohexanone, trichloroethylene, perchloroethylene, ethyl acetate, amyl acetate, butyl acetate, propylene glycol monomethyl ether and diethylene glycol monomethyl ether, methanol, ethanol, isopropanol, amyl alcohol, ethylene glycol, propylene glycol, and glycerine. Water is generally the carrier of choice for the dilution of concentrates.

Suitable solid carriers include talc, pyrophyllite clay, silica, attapulgus clay, kieselguhr, chalk, diatomaceous earth, lime, calcium carbonate, bentonite clay, Fuller's earth, cotton seed hulls, wheat flour, soybean flour, pumice, wood flour, walnut shell flour, and lignin.

It is frequently desirable to incorporate one or more surface-active agents into the compositions of the present invention. Such surface-active agents are advantageously employed in both solid and liquid compositions, especially those designed to be diluted with carrier before application. The surface-active agents can be anionic, cationic or nonionic in character and can be employed as emulsifying agents, wetting agents, suspending agents, or for other purposes. Typical surface active agents include salts of alkyl sulfates, such as diethanolammonium lauryl sulfate; alkylarylsulfonate salts, such as calcium dodecylbenzenesulfonate; alkylphenol-alkylene oxide addition products, such as nonylphenol-C_{18} ethoxylate; alcohol-alkylene oxide addition products, such as tridecyl alcohol-C_{16} ethoxylate; soaps, such as sodium stearate; alkylnaphthalene-sulfonate salts, such as sodium dibutylnaphthalenesulfonate; dialkyl esters of sulfosuccinate salts, such as sodium di(2-ethylhexyl) sulfosuccinate; sorbitol esters, such as sorbitol oleate; quaternary amines, such as lauryl trimethylammonium chloride; polyethylene glycol esters of fatty acids, such as polyethylene glycol stearate; block copolymers of ethylene oxide and propylene oxide; and salts of mono and dialkyl phosphate esters.

Other adjuvants commonly utilized in agricultural compositions include antifoam agents, compatibilizing agents, sequestering agents, neutralizing agents and buffers, corrosion inhibitors, dyes, odorants, penetration aids, spreading agents, sticking agents, dispersing agents, thickening agents, freeze point depressants, and antimicrobial agents. The compositions can also contain other compatible components, for example, other herbicides, plant growth regulants, fungicides, insecticides, and the like and can be formulated with liquid fertilizers or solid, particulate fertilizer carriers such as ammonium nitrate, and urea.

The concentration of the active ingredients in the herbicidal compositions of this invention is generally from 0.001 to 98 percent by weight. Concentrations from 0.01 to 90 percent by weight are often employed. In compositions designed to be employed as concentrates, the active ingredient is generally present in a concentration from 5 to 98 weight percent, preferably 10 to 90 weight percent. Such compositions are typically diluted with an inert carrier, such as water, before application. The diluted compositions usually applied to weeds or the locus of weeds generally contain 0.001 to 5 weight percent active ingredient and preferably contain about 0.01 to 0.5 percent.

The present compositions can be applied to weeds or their locus by the use of conventional ground or aerial dusters, sprayers, and granule applicators, by addition to irrigation water, and by other conventional means known to those skilled in the art.

The compounds of Formula I have been found to be useful preemergence and postemergence herbicides. They can be employed at non-selective (higher) rates of application to control essentially all of the vegetation in an area and, often, at selective (lower) rates of application for the selective control of undesirable vegetation in grass crops, such as corn, wheat, barley, and rice as well as in broadleaf crops, such as soybeans and cotton. While each of the compounds encompassed by Formula I is within the scope of the invention, the degree of herbicidal activity, the selectivity, and the spectrum of weed control obtained varies depending upon the substituents present. The selection of a specific compound of the invention for a specific application can be done readily without invention from the data and information presented herein along with standard testing.

The term herbicide is used herein to mean an active ingredient which controls or adversely modifies the growth of plants. An herbicidally effective or vegetation controlling amount is an amount of active ingredient which causes an adversely modifying effect and includes deviations from natural development, killing, regulation, dessication, and retardation. The terms plants and vegetation are meant to include germinant seeds, emerging seedlings and established vegetation.

Herbicidal activity is exhibited by the compounds of the present invention when they are applied directly to the plant or to the locus of the plant at any stage of growth or before emergence. The effect

observed depends upon the plant species to be controlled, the stage of growth of the plant, the application parameters of dilution and spray drop size, the particle size of solid components, the environmental conditions at the time of use, the specific compound employed, the specific adjuvants and carriers employed, and the soil type, as well as the amount of chemical applied. These and other factors can be adjusted as is known in the art to promote selective herbicidal action. Generally, it is preferred to apply the compounds of Formula I postemergence to relatively immature plants to achieve the maximum control of broadleaf weeds.

Application rates of 0.001 to 1 Kg/Ha are generally employed in postemergence operations; for preemergence applications, rates of 0.01 to 10 Kg/Ha are generally employed.

EXAMPLES

The following Examples are presented to illustrate the various aspects of this invention and should not be construed as limitations to the claims.

1. Preparation of 1-((1-Imidazolylthionyl)amino)-2-aminopyridine

A solution of ethyl O-mesitylenesulfonylacetohydroxamate (39.5 g (grams), 0.138 mol (mole)) in dioxane (225 mL (milliliters)), which was prepared according to Tetrahedron Letters 40, 4133-4135 (1972), was cooled to about 8°C. Perchloric acid (17.4 mL of 70 percent, 0.203 mol) was added dropwise with stirring over 5 min (minutes). The reaction was then allowed to warm to room temperature over 1.5 hours. It was then diluted with ice water and the solids that formed were recovered by filtration and washed with water. The damp solids obtained were mixed with chloroform (300 mL) and the organic layer that formed was added dropwise with stirring and cooling to a solution of 2-aminopyridine (12.4 g, 0.131 mol) in chloroform (300 mL) at 5°C. The temperature rose to 10°C during the addition. The reaction was allowed to warm to room temperature and then 1,1'-thiocarbonyldiimidazole (30.0 g, 0.168 mol) was added and the mixture was warmed to 40°C for several hours. The mixture was then cooled in an ice bath and the solid that slowly separated was recovered by filtration to obtain the 10.4 g (36 percent of theory) of title compound as a white powder melting at 174-175°C(d).

^{1}H NMR (Nuclear Magnetic Resonance Spectroscopy (200 megaHertz)) (DMSO-d_6(dimethyl sulfoxide)): 8.48 (s, 1H), 7.90 (s, 1H), 7.87 (d, 1H, J=4.0), 7.73 (t, 1H, J=4.0), 7.6-8.0 (broad s, 2H), 7.04 (d, 1H, J=4.0) 6.93 (s, 1H), 6.83 (t, 1H, J=4.0).

Elemental Analysis $C_9H_9N_5S$

Calc.: %C, 49.3; %H, 4.14; %N, 31.9; %S, 14.6

Found: %C, 49.5; %H, 4.06; %N, 32.2; %S, 14.3

2. Preparation of 2-Benzylthio[1,2,4]triazolo[1,5-a]pyridine

1-((1-Imidazolylthionyl)amino)-2-iminopyridine (9.9 g, 0.045 mol), benzyl chloride (8.6 g, 0.068 mol) and 1-propanol (100 mL) were mixed and heated to reflux for 2 hours. The solvent was removed by evaporation under reduced pressure and the residue obtained was mixed with dichloromethane. The resulting solution was washed with water and concentrated by evaporation under reduced pressure. The residue obtained was triturated with hexane to obtain 9.4 g (86 percent of theory) of the title compound as a white powder melting at 79-81°C.

^{1}H NMR (DMSO-d_6): 8.85 (d, 1H, J=4.0), 7.72 (d, 1H, J=4.0), 7.63 (t, 1H, J=4.0), 7.2-7.5 (m, 5H), 7.12 (t, 1H, J=4.0), 4.50 (s, 2H); ^{13}C NMR (DMSO-d_6): 163.7, 150.9, 137.6, 130.6, 129.5, 128.8, 128.7, 128.5, 128.4, 127.2, 114.6, 113.7, 34.6.

Elemental Analysis $C_{13}H_{11}N_3S$

Calc.: %C,64.7; %H,4.59; %N,17.4; %S,13.3

Found: %C,64.5; %H,4.86; %N,17.3; %S,11.8

3. Preparation of 2-Chlorosulfonyl[1,2,4]triazolo[1,5-a]pyridine

2-Benzylthio[1,2,4]triazolo[1,5-a]pyridine (8.6 g, 0.036 mol) was dissolved in dichloromethane (75 mL) and water (75 mL) and cooled in an ice bath with very good stirring. Chlorine (11.9 g, 0.168 mol) was added slowly at 3-7°C and was given another half hour to react. The layers were separated and the organic layer was dried over magnesium sulfate and sodium sulfate and then concentrated by evaporation under reduced pressure to obtain an oily residue. The residue was triturated with hexane to obtain 6.0 g (78 percent of theory) of the title compound as a white powder melting at 116-118°C.

^{1}H NMR ($CDCl_3$): 8.74 (dt, 1H, J=3.4, 0.5), 7.94 (dt, 1H, J=3.4, 0.5), 7.79 (td, 1H, J=3.4, 0.5), 7.38 (td, 1H, J=3.4, 0.5); ^{13}C NMR ($CDCl_3$): 164.2, 151.0, 132.7, 129.6, 118.5, 117.5.

4. Preparation of N-(2,6-Dichlorophenyl[1,2,4]triazolo[1,5-a]pyridine-2--sulfonamide

Chlorotrimethylsilane (7.0 mL, 6.0 g, 0.055 mol), triethylamine (7.7 mL, 5.6 g, 0.055 mol) and 2,6-dichloroaniline (4.5 g, 0.027 mol) were added with stirring to a solution of anhydrous sodium iodide (8.3 g, 0.055 mol) in acetonitrile (75 mL) and the resulting mixture was stirred for another half hour. The volatile materials were removed by evaporation under reduced pressure and the residue obtained was extracted into ether. The extract was concentrated by evaporation under reduced pressure and the residue obtained was added to a solution of 2-chlorosulfonyl[1,2,4]-triazolo[1,5-a]pyridine (2.0 g, 0.0092 mol) in acetonitrile (50 mL) with stirring. Dimethyl sulfoxide (130 µL, 0.144 g, 0.0018 mol) was then added and the mixture was allowed to react for 3.5 hours. The solvent was then removed by evaporation under reduced pressure and the residue obtained was diluted with dichloromethane. The resulting solution was washed well with water, dried over magnesium sulfate and concentrated by evaporation under reduced pressure. The residue obtained was triturated with hexane and the solids that formed were recovered by filtration. The solids were washed with ether and a small amount of dichloromethane to obtain 2.1 g (68 percent of theory) of the title compound as a white powder melting at 269-270°C.

^{1}H NMR (DMSO-d_6): 10.86 (s, 1H), 9.08 (d, 1H, J=3.4), 7.98 (d, 1H, J=4.4), 7.82 (t, 1H, J=4.4), 7.28-7.52 (m, 4H).

Elemental Analysis $C_{12}H_8Cl_2N_4O_2S$

Calc.: %C, 42.0; %H, 2.35; %N, 16.3; %S, 9.34

Found: %C, 41.9; %H, 2.22; %N, 16.3; %S, 9.08

N-(2,6-Difluorophenyl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, a white powder melting at 222-223°C, was prepared by the same procedure in 56 percent yield.

^{1}H NMR (DMSO-d_6): 10.75 (s, 1H), 9.07 (d, 1H, J=3.5), 7.98 (d, 1H, J=4.5), 7.83 (t, 1H, J=3.5), 7.02-7.48 (m, 5H).

Elemental Analysis $C_{12}H_8F_2N_4O_2S$

Calc.: %C, 46.5; %H, 2.60; %N, 18.1; %S, 10.3

Found: %C, 46.5; %H, 2.56; %N, 18.2; %S, 10.2

5. Preparation of 1,2-Diamino-4,6-dimethylpyridinium mesitylate

A solution of ethyl O-mesitylenesulfonylacetohydroxamate (51.0 g, 0.179 mol) in dioxane (300 mL) was cooled until the dioxane started to freeze. Seventy percent perchloric acid (22.5 mL, 0.263 mol) was then

added dropwise and the reaction was allowed to warm to room temperature.. After 1.5 hours the mixture was diluted with water and filtered and the collected solids were washed well with water. The damp solids were mixed with chloroform and the resulting organic solution portion of the mixture obtained was added slowly to an ice-cooled (5°C) solution of 2-amino-4,6--dimethylpyridine (21.0 g, 0.172 mol) in chloroform (300 mL). The reaction was warmed to room temperature overnight and was then heated at reflux for several hours. The solvent was evaporated and the residue was triturated with ether and a small amount of chloroform. The resulting solid was recovered by filtration and rinsed with chloroform to obtain 22.9 g (39 percent of theory) of the title compound as a white powder melting at 193-195°C.

Elemental Analysis $C_{16}H_{23}N_3O_2S$

Calc.: %C, 57.0; %H, 6.87; %N, 12.5; %S, 9.50

Found: %C, 57.1; %H, 7.01; %N, 12.6; %S, 9.51

^{1}H NMR (DMSO-d_6): 8.16 (s, 2H), 6.73 (s, 2H), 6.70 (s, 1H), 6.57 (s, 1H), 6.18 (s, 2H), 2.48 (s, 6H), 2.45 (s, 3H), 2.19 (s, 3H), 2.14 (s, 3H).

6. Preparation of 2-Benzylthio-5,7-dimethyl[1,2,4]triazolo[1,5-a]pyridine

1,2-Diamino-4,6-dimethylpyridinium mesitylate (14.0 g, 0.041 mol) and 1,1'-thiocarbonyldiimidazole (7.4 g, 0.041 mol) were mixed in chloroform (100 mL) and heated at reflux for an hour. The solvent was removed by evaporation under reduced pressure and the residue was triturated with ether and ethyl acetate and filtered to obtain 6.8 g of 1,2-diamino-4,6-dimethylpyridinium mesitylate as an insoluble solid and a filtrate. The insoluble solid was combined with another 8.3 g (15.1 g total) of the same material and with 1,1'-thiocarbonyldiimidazole (10.0 g, 0.056 mol) and the resulting mixture was stirred at room temperature for 3 days. The solvent was removed by evaporation under reduced pressure and the residue was diluted with ether and tetrahydrofuran and the mixture was filtered to obtain a filtrate. The earlier ether and ethyl acetate filtrate plus this ether and tetrahydrofuran filtrate were combined and concentrated by evaporation under reduced pressure. The resulting residue was purified by medium pressure liquid chromatography on silica gel eluting with 15 percent ethyl acetate in hexane to obtain 3.5 g (20 percent of theory) of the title compound as a white powder melting at 69-70°C.

^{1}H NMR ($CDCl_3$): 7.1-7.5 (m, 6H), 6.5 (s, 1H), 4.5 (s, 2H), 2.6 (s, 3H), 2.4 (s, 3H); ^{13}C NMR ($CDCl_3$): 164.1, 151.8, 140.9, 137.6, 137.1, 129.1, 128.4, 127.2, 114.7, 111.2, 35.9, 21.5, 17.4.

Elemental Analysis $C_{15}H_{15}N_3S$

Calc.: %C, 66.9; %H, 5.61; %N, 15.6; %S, 11.9

Found: %C, 67.0; %H, 5.90; %N, 15.9; %S, 11.7

2-Benzylthio-7-methyl[1,2,4]triazolo[1,5-a]pyridine was prepared similarly from 1-((1-imidazolylthionyl)amino)-2- imino-4-methylpyridine. The product was a white powder melting at 81-83°C.
^1H NMR ($CDCl_3$): 8.28 (d, 1H, J=3.5), 7.23-7.46 (m, 6H), 6.67 (d, 1H, J=3.5), 4.48 (s, 2H), 2.40 (s, 3H); ^{13}C NMR ($CDCl_3$): 208.9, 164.9. 141.2, 137.2, 129.0, 128.5, 127.4, 126.7, 115.4, 113.9, 35.9, 21.5.

Elemental Analysis $C_{14}H_{13}N_3S$

Calc.: %C, 65.9; %H, 5.13; %N, 16.5; %S, 12.6

Found: %C, 65.8; %H, 5.43; %N, 16.5; %S, 12.3

7. Preparation of 2-Chlorosulfonyl-5,7-dimethyl[1,2,4]triazolo[1,5-a]-pyridine

2-Benzylthio-5,7-dimethyl[1,2,4]triazolo[1,5-a]pyridine (3.3 g, 0.012 mol) was mixed with dichloromethane (50 mL) and water (50 mL) with good stirring. Chlorine (4.7 g, 0.066 mol) was added slowly at 3-5°C and the mixture allowed to react for another half hour. The organic layer was separated, dried over a mixture of magnesium and sodium sulfates, and concentrated by evaporation under reduced pressure. The residue was triturated with hexane and the resulting solids were recovered by filtration to obtain 2.7 g of the title compound as a white powder melting at 125-126°C.
^1H NMR ($CDCl_3$): 7.52 (s, 1H), 6.96 (s, 1H), 2.81 (s, 1H), 2.52 (s, 1H).

2-Chlorosulfonyl-7-methyl[1,2,4]triazolo[1,5-a]pyridine was prepared by the same procedure. An 86 percent of theory yield of this material was obtained as a pale yellow powder melting at 142-144°C.
^1H NMR ($CDCl_3$): 8.57 (d, 1H, J=3.7), 7.66 (s, 1H), 7.14 (d, 1H, J=3.7), 2.57 (s, 3H).

2-Chlorosulfonyl-5-chloro-7-methyl[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. A 91 percent of theory yield of this material was obtained as a pale yellow powder melting at 130-132°C.
^1H NMR ($CDCl_3$): 7.62 (s, 1H), 7.25 (s, 1H), 2.57 (s, 3H).

2-Chlorosulfonyl-5,7-dichloro[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. A 100 percent yield of this compound was obtained as a pale yellow solid melting at 164-166°C.

Elemental Analysis $C_6H_2Cl_2N_3O_2S$

Calc.: %C, 25.2; %H, 0.70; %N, 14.7; %S, 11.2

Found: %C, 25.2; %H, 0.65; %N, 14.4; %S, 10.9

2-Chlorosulfonyl-5-chloro[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. An 80 percent yield of this compound was obtained as a brownish powder melting at 102-103°C.

2-Chlorosulfonyl-5-bromo-1,2,4-triazolo[1,5-a]pyridine was prepared similarly. An 89 percent yield of this compound was obtained as a brown powder melting at 96-97°C.

6-Bromo-2-chlorosulfonyl-8-methoxy[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. An 85 percent yield of this compound was obtained as a yellow solid.

^1H NMR ($CDCl_3$): 8.47 (s, 1H), 7.11 (s, 1H), 4.13 (s, 3H).

6-Chloro-2-chlorosulfonyl-8-methoxy[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. An 84 percent yield of this compound was obtained as an orange gum.

^1H NMR ($CDCl_3$): 8.38 (d, 1H, J=1.8), 7.00 (d, 1H, J=1.8), 4.13 (s, 3H).

8-Chloro-2-chlorosulfonyl-5-methoxy[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. A 96 percent yield of this compound was obtained as a tan powder melting at 147-149°C.

8-Bromo-2-chlorosulfonyl-5-methoxy[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. A 90 percent yield of this compound was obtained as a tan powder melting at 120-122°C with decomposition.

7-Bromo-2-chlorosulfonyl-5-methoxy[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. A 95 percent yield of this compound was obtained as a tan powder melting at 113-115°C.

8-Chloro-2-chlorosulfonyl[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. An 84 percent yield of this compound was obtained as a pale yellow powder melting at 129-131°C.

8. Preparation of 1,2-Diamino-4-methylpyridinium mesitylate

Ethyl O-mesitylenesulfonylacetohydroxamate (53.4 g, 0.191 mol) was dissolved in dioxane (300 mL) and cooled below 10°C. Perchloric acid (24.5 mL of 70 percent, 0.286 mol) was added dropwise with stirring. After 2 hours the solution was diluted with ice water and filtered to recover the

solids. The damp solids were mixed with chloroform (300 mL) and the organic solution obtained was recovered and added to 2-amino-4-methylpyridine (19.6 g, 0.181 mol) in chloroform (300 mL) at 5-10°C. The solution was warmed to room temperature for an hour. The solvent was then removed by evaporation under reduced pressure and the residue obtained was triturated with ether and then dichloromethane. The solids obtained were recovered by filtration to obtain 42.7 g (73 percent of theory) of the title compound as a white powder melting at 133-136°C

^{1}H NMR (DMSO-d_6): 8.15 (s, 2H), 7.88 (d, 1H, J=3.4), 6.61-6.83 (m, 5H), 2.49 (s, 6H), 2.26 (s, 3H), 2.16 (s, 3H).

9. Preparation of 1-((1-Imidazolylthionyl)amino)-2-imino-4-methylpyridine

1,2-Diamino-4-methylpyridinium mesitylate (1.0 g, 0.0031 mol) and 1,1'-thiocarbonyldiimidazole (0.6 g, 0.0031 mol) were mixed in chloroform (25 mL) at room temperature. After a few hours the yellow color was gone and more 1,1'-thiocarbonyldiimidazole (0.6 g, 0.0031 mol was added and the mixture was stirred overnight. The volatiles were removed by evaporation under reduced pressure and the residue obtained was triturated with ether. The resulting solids were purified by medium pressure liquid chromatography on silica gel eluting initially with 2 percent methanol in dichloromethane and gradually changing to 5 percent methanol in dichloromethane. The solvent was removed by evaporation under reduced pressure and the residue obtained was mixed with ether. The resulting solids were recovered by filtration to obtain 0.25 g (35 percent of theory) of the title compound as an off-white powder melting at 176-177°C.

^{1}H NMR (DMSO-d_6): 8.46 (s, 1H), 7.87 (s, 1H), 7.74 (d, 1H, J=3.4), 7.58 (broad s, 2H), 6.92 (s, 1H), 6.80 (s, 1H), 6.68 (dd, 1H, J=1.0, 3.4), 2.34 (s, 3H).

Elemental Analysis $C_{10}H_{11}N_5S$

Calc.: %C, 51.5; %H, 4.75; %N, 30.0; %S, 13.7

Found: %C, 51.4; %H, 4.85; %N, 30.2; %S, 13.7

1-((1-Imidazolylthionyl)amino)-2-imino-3,5-dibromopyridine was prepared in the same manner. The product was obtained in 96 percent yield as a pale yellow solid melting at 185-186°C.

^{1}H NMR (DMSO-d_6): 8.51 (d, 1H, J=1.8), 8.46 (s, 1H), 8.41 (d, 1H, J=2.1), 8.13 (brs, 2H), 7.86 (s, 1H), 6.93 (s, 1H).

1-((1-Imidazolylthionyl)amino)-2-imino-3,5-dichloropyridine was prepared in the same manner. The product was obtained in 86 percent yield as a pale

yellow solid melting at 176-178°C.
Elemental Analysis $C_9H_7N_5Cl_2S$

Calc.: %C, 37.5; %H, 2.45; %N, 24.3; %S, 11.1

Found: %C, 37.7; %H, 2.50; %N, 24.0; %S, 11.2

^1H NMR (DMSO-d_6): 8.48 (s, 1H), 8.39 (s, 1H), 8.38 (s, 1H), 8.29 (brs, 2H), 7.89 (s, 1H), 6.95 (s, 1H); ^{13}C NMR (DMSO-d_6): 181.1, 147.7, 138.7, 138.0, 136.4, 128.0, 120.5, 118.4, 117.8, 115.7.

10. Preparation of N-(2,6-Dichlorophenyl)-7-methyl[1,2,4]triazolo[1,5-a]-pyridine-2-sulfonamide

2-Chlorosulfonyl-7-methyl[1,2,4]triazolo[1,5-a]pyridine (1.2 g, 0.0052 mol), 2,6-dichloroaniline (1.7 g, 0.010 mol) and pyridine (0.40 g, 0.0052 mol) were dissolved in anhydrous acetonitrile (20 mL). Dimethyl sulfoxide (60 µL, 0.0008 mol) was added with stirring. The reaction was allowed to stir overnight. The volatiles were removed by evaporation under reduced pressure and the residue obtained was taken up in dichloromethane. The resulting mixture was washed well with dilute aqueous hydrochloric acid and the organic solution phase was recovered and concentrated by evaporation under reduced pressure. The resulting residue was triturated with hexane and the solids that formed were recovered by filtration and dried to obtain 0.7 g (38 percent of theory) of the title compound as a tan powder melting at 232-234°C.
Elemental Analysis $C_{13}H_{10}Cl_2N_4O_2S$

Calc.: %C, 43.7; %H, 2.82; %N, 15.7; %S, 8.98

Found: %C, 44.0; %H, 2.87; %N, 15.5; %S, 9.15.

^1H NMR (DMSO-d_6): 10.80 (s, 1H), 8.91 (d, 1H, J=3.5), 7.42 (s, 1H), 7.19-7.50 (m, 4H), 2.47 (s, 3H).

11. Preparation of 4-Methylglutaconic Anhydride

The procedure found in J. Am. Chem. Soc., 75, 2377-9 (1953) was generally followed. Ethyl isodehydroacetate (100 g, 0.51 mol) was added to a warm solution of sodium hydroxide (68.5 g., 0.71 mol) in water (500 mL) and stirred for an hour until the mixture became clear. The solution was acidified with concentrated hydrochloric acid (200 mL) and was extracted with ethyl acetate. The extract was dried over magnesium sulfate and concentrated by evaporation under reduced pressure. The residue was mixed with acetic anhydride (250 mL) and the resulting mixture was heated at reflux for 20-30 min. The solvent was removed by evaporation under reduced pressure and the residue obtained was crystallized from ether to obtain 60.8 g (94 percent of theory) of the title compound as a tan powder melting

at 70-72°C.
^{1}H NMR ($CDCl_3$): 6.01 (s, 1H), 3.41 (s, 2H), 2.04 (s, 3H). The reaction works equally with methyl rather than ethyl isodehydroacetate. Acetyl chloride can be used instead of acetic anhydride, but acetic anhydride typically gave better results.

12. Preparation of 2-Benzylthio-5-hydroxy-7-methyl[1,2,4]triazolo[1,5-a]-pyridine

A mixture of thiosemicarbazide (50.0 g, 0.554 mol) and benzyl chloride (67.1 g, 0.53 mol) in 2-propanol (1 L) was heated to reflux with stirring for 2 hours. The reaction mixture was then cooled and 4-methyl-glutaconic anhydride (60.8 g, 0.482 mol) and triethylamine (75 mL, 53.6 g, 0.53 mol) were added. The reaction mixture was again heated at reflux with stirring for an hour. Sodium methoxide in methanol solution (250 mL of 25 percent, 1.09 mol) was then added and the yellow-brown mixture obtained was heated at reflux with stirring for 2.5 hours. The volatiles were removed by evaporation under reduced pressure and the residue obtained was combined with dilute aqueous acetic acid (150 mL) and ethyl acetate. The organic phase was recovered, washed well with water and concentrated by evaporation under reduced pressure. The residue obtained was heated with a heat gun under reduced pressure for 30 minutes until the bubbling had stopped and the reaction mixture had solidified. The mixture was cooled and diluted with methanol and the resulting solids were recovered by filtration to obtain 54.5 g (41 percent of theory) of the title compound as a yellow-brown powder melting at 214-216°C.
Elemental Analysis $C_{13}H_{11}ClN_4S$

Calc.: %C, 62.0; %H, 4.83; %N, 15.5; %S, 11.9
Found: %C, 61.9; %H, 4.88; %N, 15.5; %S, 11.5

13. Preparation of 2-Benzylthio-5-chloro-7-methyl[1,2,4]triazolo[1,5-a]-pyridine

N,N-Dimethylaniline (21,9 g, 0.18 mol) was added slowly to a mixture of 2-benzylthio-5-hydroxy-7-methyl[1,2,4]triazolo[1,5-a]pyridine (44.5 g, 0.164 mol) in 150 mL of phosphorus oxychloride with stirring. The mixture was heated at reflux with stirring for 20 hours. The excess phosphorus oxychloride was then removed by evaporation under reduced pressure. The residue obtained was dissolved in ethyl acetate, washed well with water and quickly concentrated by evaporation under reduced pressure to drive off the excess water. The residue was again dissolved in ethyl acetate and the resulting mixture was filtered with suction through a bed

of silica gel. The filtrate was concentrated by evaporation under reduced pressure and the residue obtained was mixed with hexane. The resulting mixture was filtered to recover the solids and dried to obtain the 37.5 g.(79 percent of theory) of the title compound as a tan powder melting at 108-110°C.

Elemental Analysis $C_{14}H_{12}ClN_3S$

Calc.: %C, 58.0; %H, 4.17; %N, 14.5; %S, 11.1

Found: %C, 58.4; %H, 3.93; %N, 14.6; %S, 11.0

^1H NMR ($CDCl_3$): 7.20-7.52 (m, 6H), 6.86 (s, 1H), 4.51 (s, 2H), 2.44 (s, 3H); ^{13}C NMR ($CDCl_3$): 165.4, 152.5, 141.7, 131.2, 129.1, 128.4, 128.1, 127.3, 115.2, 112.2, 35.8, 21.4.

14. Preparation of 2-Benzylthio-5-methoxy-7-methyl[1,2,4]-triazolo[1,5-a]pyridine

A mixture of 2-benzylthio-5-chloro-7-methyl[1,2,4]triazolo-[1,5-a]pyridine (5.0 g, 0.017 mol), sodium methoxide in methanol (16 mL of 25 percent, 3.7 g, 0.070 mol) and methanol (100 mL) were heated at reflux with stirring for 4 hours. The reaction mixture was then cooled, acidified with acetic acid (10 mL), and concentrated by evaporation under reduced pressure. The residue obtained was dissolved in dichloromethane and the resulting solution was washed well with water, dried over magnesium sulfate, and concentrated by evaporation under reduced pressure. The residue obtained was mixed with hexane and filtered to recover the solids. The solids were dried to obtain 4.7 g (97 percent of theory) of the title compound as a tan powder melting at 85-87°C.

^1H NMR ($CDCl_3$): 7.24-7.46 (m, 5H), 7.02 (s, 1H), 6.06 (s, 1H), 4.51 (s, 2H), 4.10 (s, 3H), 2.43 (s, 3H).

Elemental Analysis $C_{15}H_{15}N_3OS$

Calc.: %C, 63.1; %H, 5.30; %N, 14.7; %S, 11.2

Found: %C, 62.9; %H, 5.12; %N, 14.7; %S, 11.3

15. Preparation of N-(2,6-Dichlorophenyl)-5-chloro-7-methyl[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide

The title compound was prepared from 2-chlorosulfonyl-5-chloro--7-methyl[1,2,4]triazolo[1,5-a]pyridine using the procedure of Example 10. The white solid compound, which was obtained in 62 percent yield, had a melting point of 257-258°C.

Elemental Analysis $C_{13}H_9Cl_3N_4O_2S$

Calc.: %C, 39.9; %H, 2.32; %N, 14.3; %S, 8.19

Found: %C, 39.8; %H, 2.35; %N, 14.3; %S, 8.03

^{1}H NMR (DMSO-d_6): 10.80 (s, 1H), 7.81 (s, 1H), 7.60 (s, 1H), 7.03-7.48 (m, 3H), 2.48 (s, 3H).

16. Preparation of N-(2,6-Dichlorophenyl)-5-methoxy-7-methyl[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide

N-(2,6-Dichlorophenyl)-5-chloro-7-methyl[1,2,4]triazolo-[1,5-a]pyridine-2-sulfonamide (3.0 g, 0.0077 mol) and 25 percent sodium methoxide in methanol (12 mL, 2.8 g, 0.050 mol) were combined in methanol (100 mL) and heated to reflux with stirring for 2 hours. The reaction mixture was cooled and acidified with acetic acid and the volatiles were removed by evaporation under reduced pressure. The residue obtained was diluted with dichloromethane and the mixture was washed with water. The organic solution phase was filtered and the filtrate was concentrated by evaporation under reduced pressure. The residue obtained was mixed with ether and filtered to recover the solids. The solids were dried to obtain 2.6 g (87 percent of theory) of the title compound as a white powder melting at 269-270°C(d).

Elemental Analysis $C_{14}H_{12}Cl_2N_4O_3S$

Calc.: %C, 43.4; %H, 3.13; %N, 14.5; %S, 8.27

Found: %C, 43.3; %H, 3.13; %N, 14.4; %S, 8.18

^{1}H NMR (DMSO-d_6): 10.79 (s, 1H), 7.28-7.50 (m, 4H), 6.72 (s, 1H), 4.12 (s, 3H), 2.47 (s, 3H).

N-(2,6-Difluorophenyl)-5-methoxy-7-methyl[1,2,4]triazolo[1,5-a]pyridine-2--sulfonamide was prepared by the same procedure from N-(2,6-difluoro-phenyl)-5-chloro-7-methyl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide. The product was obtained as a light tan powder melting at 248-249°C.

Elemental Analysis $C_{14}H_{12}F_2N_4O_3S$

Calc.: %C, 47.6; %H, 3.41; %N, 15.8; %S, 9.05

Found: %C, 47.4; %H, 3.48; %N, 15.8; %S, 9.05

^{1}H NMR (DMSO-d_6): 10.66 (s, 1H), 7.02-7.46 (m, 4H), 6.73 (s, 1H), 4.12 (s, 3H), 2.47 (s, 3H).

17. Preparation of 2-Hydrazino-3-nitropyridine

2-Chloro-3-nitropyridine (100 g, 0.63 mol), hydrazine mono-hydrate (70.4 mL, 72.6 g, 1.45 mol) and methanol (1.3 L) were mixed and heated to reflux with stirring. After 30 min the reaction mixture was cooled and filtered collecting the insoluble materials. The filtrate was concentrated by evaporation under reduced pressure and the residue obtained as well as the insoluble materials from the filtration were diluted with water. The insoluble solids present were collected by filtration, washed

with water, and dried to obtain 95.2 g (98 percent of theory) of the title compound as a bright yellow powder melting at 168-169°C.

Elemental Analysis $C_5H_6N_4O_2$

Calc.: %C, 39.0; %H, 3.90; %N, 36.4; %S, 8.27

Found: %C, 39.1; %H, 4.17; %N, 36.1; %S, 8.18

18. Preparation of 2-Benzylthio-8-nitro[1,2,4]triazolo[1,5-a]pyridine

2-Hydrazino-3-nitropyridine (95.2 g, 0.618 mol) was combined with acetonitrile (1 L) and carbon disulfide (114 mL, 143.9 g, 1.89 mol) was added. The resulting mixture was stirred for 1.5 hours. Hydrogen peroxide (78.6 mL of 30 percent aqueous solution, 23.6 g, 0.693 mol) was added dropwise over a 20-min period with cooling at 15-20°C. The mixture was stirred for another 2 hours and was then cooled in an ice bath. Benzyl chloride (91.7 g, 0.72 mol) was added and then triethylamine (110 mL, 79.6 g, 0.79 mol) was added slowly with stirring over a 2-hour period. The reaction was exothermic. The mixture was stirred at room temperature over the weekend. The volatiles were removed by evaporation under reduced pressure and the residue obtained was diluted with dichloromethane and water. The resulting mixture was filtered through Celite® to remove the precipitated sulfur. The organic phase of the filtrate was recovered, washed with water, and concentrated by evaporation under reduced pressure. The solid residue obtained was diluted with hexane, recovered by filtration, and dried to obtain 174.0 g (98 percent of theory) of the title compound as a brown powder melting at 125-126°C(d).

Elemental Analysis $C_{13}H_{10}N_4O_2S$

Calc.: %C, 54.5; %H, 3.52; %N, 19.6; %S, 11.2

Found: %C, 54.8; %H, 3.64; %N, 19.7; %S, 11.3

19. Preparation of 8-Amino-2-benzylthio[1,2,4]triazolo[1,5-a]pyridine

2-Benzylthio-8-nitro[1,2,4]triazolo[1,5-a]pyridine (174.0 g, 0.61 mol), iron filings (204.2 g., 3.65 mol) and acetic acid (2 L) were combined and heated with stirring at 70-80°C for 6 hours. The reaction mixture was cooled and diluted with water and dichloromethane. The resulting mixture was filtered through Celite®, the liquid phases in the filtrate were separated, and the aqueous layer was extracted with a little more dichloromethane. The organic phase and extract were combined and washed several times with water and then with dilute aqueous sodium hydroxide. The resulting organic solution was concentrated by evaporation under reduced pressure and the residue obtained was mixed with ether. The insoluble solids were collected by filtration and dried to obtain 106.3 g

of the title compound as a brown powder melting at 116-117°C. An additional 14.2 g of lower purity product was isolated from the ether filtrate (77 percent of theory total yield). This reduction was also carried out with iron powder and calcium chloride in aqueous ethanol and with stannous chloride in hydrochloric acid.

20. Preparation of 8-Amino-2-benzylthio-5,7-dichloro[1,2,4]triazolo-[1,5-a]pyridine

8-Amino-2-benzylthio[1,2,4]triazolo[1,5-a]pyridine (20.0 g, 0.078 mol), N-chlorosuccinimide (10.4 g, 0.078 mol) and carbon tetrachloride were combined and heated to reflux with stirring for 1 hour. The reaction mixture was cooled, more N-chlorosuccinimide (10.4 g) was added, and the reaction heated to reflux with stirring for another hour. The reaction mixture was then cooled and filtered. The filtrate was concentrated by evaporation under reduced pressure and the residue obtained was purified by column chromatography on silica gel eluting with dichloromethane. The product fractions were concentrated by evaporation under reduced pressure and the residues were combined and mixed with ether. The insoluble solids were collected by filtration and dried to obtain 18.0 g (71 percent of theory) of the title compound as a light tan powder melting at 118-119°C.

21. Preparation of 2-Benzylthio-5,7-dichloro[1,2,4]triazolo[1,5-a]pyridine

8-Amino-2-benzylthio-5,7-dichloro[1,2,4]triazolo[1,5-a]pyridine (25.8 g, 0.079 mol), t-butyl nitrite (18.9 mL, 16.4 g, 0.158 mol) and tetrahydrofuran (1.5 L) were combined and heated at reflux with stirring. Gas evolution began immediately and stopped after a few minutes, but the reaction was heated at reflux for an hour. The volatiles were removed by evaporation under reduced pressure and the residue obtained was chromatographed on silica gel eluting with dichloromethane. The product fractions were concentrated by evaporation under reduced pressure and the residue obtained was mixed with ether. The insoluble solid material was collected by filtration. The ether filtrate was concentrated by evaporation under reduced pressure and the residue was rechromatographed on silica gel eluting with 10 percent ethyl acetate in hexane. The product fractions were concentrated by evaporation under reduced pressure and the residue obtained was combined with the insoluble solid material obtained before to obtain 12.2 g (50 percent of theory) of the title compound as a red-brown powder melting at 88-89°C.

Elemental Analysis $C_{13}H_9Cl_2N_3S$

Calc: %C, 50.3; %H, 2.92; %N, 13.6; %S, 10.3

Found: %C, 50.1; %H, 2.92; %N, 13.6; %S, 10.2

2-Benzylthio-5,7-dibromo[1,2,4]triazolo[1,5-a]pyridine was prepared similarly from 8-amino-2-benzylthio-5,7-dibromo[1,2,4]triazolo[1,5-a]-pyridine. A 32 percent yield of this compound was obtained as a light tan powder melting at 113-114°C.

22. Preparation of N-(2,6-Dichlorophenyl)-5-methoxy-7-chloro[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide

Sodium methoxide in methanol (1.1 mL of 25 percent solution, 0.26 g, 0.005 mol) was added to a solution of N-(2,6-dichlorophenyl)-5,7--dichloro[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide (0.9 g, 0.02 mol) in dimethyl sulfoxide (30 mL) at ambient temperature with stirring. The reaction was complete in a few minutes, but was stirred for 30 min. The mixture was then acidified with acetic acid and diluted with dichloro-methane. The resulting organic phase was recovered and washed with water and the volatiles were removed by evaporation under reduced pressure. The residue obtained was mixed with hexane and the insoluble solids were collected by filtration and dried to obtain 0.8 g (90 percent of theory) of the title compound as a light tan powder melting at 232-234°C(d).

Elemental Analysis $C_{13}H_9Cl_3N_4O_3S$

Calc.: %C, 38.3; %H, 2.22; %N, 13.7; %S, 7.87

Found: %C, 38.3; %H, 2.12; %N, 13.7; %S, 7.63

23. Preparation of N-(2,6-Dichlorophenyl)-5,7-dimethoxy[1,2,4]triazolo-[1,5-a]pyridine-2-sulfonamide

Sodium methoxide in methanol (3.0 mL of 25 percent solution, 0.71 g, 0.013 mol) was added to a solution of N-(2,6-dichlorophenyl)-5--methoxy-7-chloro[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide (0.66 g, 0.0016 mol) in dimethyl sulfoxide (30 mL) with stirring over several hours. The mixture was allowed to react and was then acidified with acetic acid and diluted with dichloromethane. The resulting organic phase was recovered and washed with water and the volatiles were removed by evaporation under reduced pressure. The residue obtained was chromato-graphed on silica gel starting with 0.5 percent acetic acid in dichloro-methane and gradually increasing the strength to 0.5 percent acetic acid plus 1.0 percent ethanol in dichloromethane. The product fractions were concentrated by evaporation under reduced pressure to obtain 118 mg (13 percent of theory) of the title compound as a pale yellow powder melting at

252-253°C(d).

Elemental Analysis $C_{14}H_{12}Cl_2N_4O_4S$

Calc.: %C, 41.7; %H, 3.00; %N, 13.9; %S, 7.95

Found: %C, 41.8; %H, 2.67; %N, 13.6; %S, 8.00

24. Preparation of N-(2-fluoro-5-methyl-3-pyridinyl)-5-methoxy-7-methyl-[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide

To a solution of 0.70 g (1.9 mmol) of N-(2-fluoro-5-methyl-3--pyridinyl)-5-chloro-7-methyl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide in 25 mL of dry dimethyl sulfoxide was added with stirring 1.0 mL (4.6 mmol) of sodium methoxide as a 25 percent solution in methanol. After 3 min, 3 mL of acetic acid was added and the solution was diluted with 600 mL of dichloromethane. The resulting solution was washed with water (5 x 100 mL), dried over magnesium sulfate, filtered, and concentrated by evaporation under reduced pressure to obtain 0.5 g (71 percent of theory) of the title compound as a white solid melting at 262-264°C with decomposition.

Elemental Analysis $C_{13}H_{11}ClFN_5O_3S$

Calc.: %C, 42.0; %H, 2.98; %N, 18.8; %S, 8.62

Found: %C, 41.9; %H, 2.93; %N, 18.8; %S, 8.47

^1H NMR (DMSO-d_6): 10. 7 (br, 1H), 8.1 (dd, 1H), 8.05 (dd, 1H), 7.4 (s, 1H), 6.8 (s, 1H), 4.1 (s, 1H), 2.5 (s, 3H).

25. Preparation of 8-Amino-2-benzylthio-5-chloro[1,2,4]triazolo[1,5-a]-pyridine

A solution of 8-amino-2-benzylthio[1,2,4]triazolo[1,5-a]-pyridine (14.0 g, 0.0546 mol) and 1,3-dichloro-5,5-dimethylhydantoin (5.4 g, 0.0273 mol) were combined in 500 mL of dichloromethane and the mixture was heated at reflux with stirring for two hours. Additional 1,3-dichloro--5,5-dimethylhydantoin (5.0 g, 0.025 mol) was added and the reaction was heated with stirring for an additional hour. The reaction mixture was cooled and dilute aqueous sodium bisulfite was added with stirring and allowed to react for an hour. The mixture was then washed with water and the volatiles were removed by evaporation under reduced pressure. The residue obtained was chromatographed on silica gel eluting with dichloro-methane to obtain 6.0 g (38 percent of theory) of the title compound as a light tan powder melting at 113-114°C.

Elemental Analysis $C_{13}H_{11}ClN_4S$

Calc.: %C, 53.7; %H, 3.81; %N, 19.3; %S, 11.0

Found: %C, 53.9; %H, 3.84; %N, 19.5; %S, 11.0

26. Preparation of 2-Benzylthio-5-chloro[1,2,4]triazolo[1,5-a]pyridine

A solution of 8-amino-2-benzylthio-5-chloro[1,2,4]triazolo-[1,5-a]pyridine (9.0 g, 0.031 mol) and acetic acid (2.0 g, 0.033 mol) in tetrahydrofuran (100 mL) was added dropwise with stirring over 30 min to a solution of t-butyl nitrite (6.4 g, 0.062 mol) in tetrahydrofuran (500 mL) at 50-55°C and allowed to react another 15 minutes after the addition was complete. The volatiles were removed by evaporation under reduced pressure and the residue obtained was chromatographed on silica gel eluting with a gradient of 5-15 percent ethyl acetate in hexane. The product fractions were concentrated by evaporation under reduced pressure to obtain 3.4 g (37 percent of theory) of the title compound as a dark low-melting solid.

27. Preparation of 8-Amino-2-benzylthio-5-bromo[1,2,4]triazolo[1,5-a]-pyridine

8-Amino-2-benzylthio[1,2,4]triazolo[1,5-a]pyridine (25.6 g, 0.1 mol), N-bromosuccinimide (17.8 g, 0.1 mol) and 2 L of dichloromethane were combined with stirring for an hour. The solution was washed with dilute aqueous sodium bisulfite and then with water and the volatiles were removed by evaporation under reduced pressure. The residue obtained was chromatographed on silica gel eluting with 25 percent ethyl acetate in hexane. The product fractions were concentrated by evaporation under reduced pressure and the solid residue obtained was extracted with ether and dried to obtain 17.5 g (52 percent of theory) of the title compound as a light tan powder melting at 125-126°C.

Elemental Analysis $C_{13}H_{11}BrN_4S$

Calc.: %C, 46.6; %H, 3.31; %N, 16.7; %S, 9.56

Found: %C, 46.7; %H, 3.34; %N, 17.0; %S, 9.56

28. Preparation of 8-Amino-2-benzylthio-5-chloro[1,2,4]triazolo[1,5-a]-pyridine by Reduction

A mixture of 1.0 g (3.5 mmol) of 2-benzylthio-8-nitro[1,2,4]-triazolo[1,5-a]pyridine, 1.35 g (3.85 mmol) of stannic chloride pentahydrate, and 10 mL of concentrated hydrochloric acid was prepared and heated to 90°C with stirring. A solution of 1.99 g (10.5 mmol) of stannous chloride in 10 mL of concentrated aqueous hydrochloric acid was added slowly over a 1-hour period. After a short reaction period the mixture was allowed to cool and the solids present were collected by filtration. The collected solids were placed in water and the mixture was basified with dilute aqueous sodium hydroxide. The resulting mixture was extracted with dichloromethane and the organic extract was concentrated by evaporation

under reduced pressure to obtain 0.60 g (66 percent of theory) of product as a brown solid. This solid was found to be 93 percent the title compound and 7 percent 8-amino-2-benzylthio[1,2,4]triazolo[1,5-a]pyridine by high pressure liquid chromatography. The pure compound melts at 113-114°C.

29. Preparation of 8-Amino-2-benzylthio-5-ethoxy[1,2,4]triazolo[1,5-a]-pyridine by Reduction

2-Benzylthio-8-nitro[1,2,4]triazolo[1,5-a]pyridine (5.0 g, 0.017 mol) and stannic chloride pentahydrate (7.3 g, 0.021 mol) were mixed with 100 mL of ethanol and the mixture was heated to reflux with stirring. A solution of stannous chloride (13.2 g, 0.07 mol) in 100 mL of ethanol was added dropwise with stirring over 45 minutes and the heating was continued another 20 minutes after the addition was complete. The reaction mixture was diluted with dichloromethane. The resulting mixture was washed well with 2N aqueous hydrochloric acid and was then concentrated by evaporation under reduced pressure. The residue was chromatographed on silica gel eluting first with 5 percent ethyl acetate in dichloromethane and gradually increasing to 20 percent ethyl acetate in dichloromethane. The product fractions were concentrated by evaporation under reduced pressure and the residue was dissolved in dichloromethane. The resulting solution was washed well with 2N aqueous sodium hydroxide, dried over magnesium sulfate, and concentrated by evaporation under reduced pressure. The residue was mixed with hexane and the insoluble solids were recovered by filtration and dried to obtain 1.7 g (33 percent of theory) of the title compound as a dark tan powder melting at 106-107°C.

Elemental Analysis $C_{15}H_{16}N_4OS$

Calc.: %C, 60.0; %H, 5.37; %N, 18.7; %S, 10.7

Found: %C, 59.8; %H, 5.49; %N, 18.8; %S, 10.5

30. Preparation of 1,2-Diamino-3,5-dichloropyridinium Mesitylate

2-Amino-3,5-dichloropyridine (9.48 g, 58.1 mmol) was dissolved in chloroform (100 mL) in a round bottom flask and the mixture was cooled to 5°C in an ice bath. To this mixture was added dropwise with stirring a freshly prepared solution of O-mesitylenesulfonyl-hydoxylamine (15.5 g, 69.8 mmol) in chloroform. (warning; this compound is an explosive solid). A thick white precipitate began to form after 15 min. The mixture was allowed to warm to room temperature while stirring overnight. The solids present were recovered by filtration, washed with chloroform (3 x 100 mL), and dried to obtain 17.5 g (80 percent of theory) of the title compound as a white crystalline solid

melting at 231-232°C.

Infrared Analysis (KBr): 3407, 3203, 3025, 2936, 1656, 1369, 1182, 1086, 1014, 679, 600, 548 cm^{-1};

^1H NMR (DMSO-d_6): 8.81 (s, 2H), 8.42 (s, 2H), 7.01 (s, 2H), 6.73 (s, 2H), 2.50 (s, >6H), 2.16 (s, 3H).

1,2-Diamino-3,5-dibromopyridinium mesitylate was prepared similarly and was obtained in 92 percent yield as an off-white solid melting at 212-213°C.

^1H NMR (DMSO-d_6): 8.67 (brs, 2H), 8.58 (d, 1H, J=2.1), 8.47 (d, 1H, J=2.1), 6.99 (s, 2H), 6.74 (s, 2H), 2.49 (s, >6H), 2.17 (s, 3H).

Elemental Analysis $C_{14}H_{17}Br_2N_3O_3S$

Calc.: %C, 36.1; %H, 3.68; %N, 9.01; %S, 6.88

Found: %C, 35.9; %H, 3.98; %N, 8.89; %S, 6.86

31. Preparation of 2-Benzylthio-6,8-dichloro[1,2,4]triazolo[1,5-a]-pyridine

1-((1-Imidazolylthionyl)amino)-2-imino-3,5-dichloropyridine (1.0 g, 3.5 mmol) was combined with n-butanol (10 mL) in a round bottom flask and heated to 100°C with stirring. Benzyl chloride (0.48 mL, 4.2 mmol) was added and the mixture was heated at reflux with stirring for 1.5 hour. The volatiles were then removed by evaporation under reduced pressure and the solid residue obtained was triturated with hexane (20 mL), water (20 mL), and hexane (20 mL). The resulting solid was washed with hexane on a filter and dried to obtain 0.80 g (74 percent of theory) of the title compound as a pale yellow solid melting at 115-116°C.

Elemental Analysis $C_{13}H_9N_3Cl_2S$

Calc.: %C, 50.3; %H, 2.92; %N, 13.6; %S, 10.3

Found: %C, 49.4; %H, 2.32; %N, 13.8; %S, 10.1

^1H NMR (DMSO-d_6): 9.28 (s, 1H), 8.08 (s, 1H), 7.46 (d, 2H, J=7.2), 7.27-7.31 (m, 3H), 4.50 (s, 2H); ^{13}C NMR (DMSO-d_6): 164.9, 148.2, 137.2, 130.5, 128.9, 128.5, 127.4, 126.5, 119.7, 119.4, 34.7.

2-Benzylthio-6,8-dibromo[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. The product was obtained in 84 percent yield as a pale yellow solid melting at 123-124°C.

Elemental Analysis $C_{13}H_9N_3Br_2S$

Calc.: %C, 39.1; %H, 2.27; %N, 10.5; %S, 8.03

Found: %C, 38.8; %H, 2.34; %N, 10.6; %S, 8.17

^1H NMR (DMSO-d_6): 9.34 (d, 1H, J=1.8), 8.23 (d, 1H, J=1.5), 7.47 (d, 2H, J=6.9), 7.25-7.33 (m, 3H), 4.49 (s, 2H).

32. Preparation of 2-Benzylthio-6-bromo-8-methoxy[1,2,4]triazolo-[1,5-a]pyridine

2-Benzylthio-6,8-dibromo[1,2,4]triazolo[1,5-a]pyridine (9.5 g, 23.8 mmol) was mixed with acetonitrile (50 mL) in a round bottom flask. Sodium methoxide (13.1 mL of 25 percent solution in methanol, 57.1 mmol) was added and the mixture was heated at reflux for 2 hours. Glacial acetic acid (10 mL) was added and the entire reaction mixture was poured into a mixture of ice and water (300 mL). The brown precipitate that formed was recovered by filtration and dried. This was chromatographed on silica gel eluting with a 1:1 mixture of ethyl acetate and hexane. Product-containing fractions were combined and concentrated under reduced pressure to obtain 6.58 g (80 percent of theory) of the title compound as a pale yellow solid.

Elemental Analysis $C_{14}H_{12}N_3BrSO$

Calc.: %C, 48.0; %H, 3.45; %N, 12.0; %S, 9.75

Found: %C, 47.8; %H, 3.36; %N, 11.9; %S, 9.22

^1H NMR (DMSO-d_6): 8.85 (d, 1H, J=1.5), 7.42 (d, 2H, J=7.5), 7.23-7.31 (m, 4H), 4.46 (s, 2H), 3.97 (s, 3H).

2-Benzylthio-6-chloro-8-methoxy[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. The product was obtained in 87 percent yield as a tan solid melting at 125-126°C.

^1H NMR (DMSO-d_6): 8.84 (d, 1H, J=1.5), 7.46 (d, 2H, J=6.9), 7.26-7.36 (m, 3H), 7.24 (d, 1H, J=1.5), 4.50 (s, 2H), 4.02 (s, 3H).

2-Benzylthio-6-chloro-8-ethoxy[1,2,4]triazolo[1,5-a]pyridine was prepared similarly. The product was obtained in 100 percent yield as a pale orange oil.

^1H NMR (DMSO-d_6): 8.83 (d, 1H, J=1.2), 7.45 (d, 2H, J=7.2), 7.26-7.34 (m, 3H), 7.22 (d, 9H, J=1.2), 1H), 4.49 (s, 2H), 4.28 (q, 2H, J=7.2), 1.41 (t, 3H, J=6.9).

33. Preparation of 6-Bromo-5-chloro-2-chlorosulfonyl-8-methoxy[1,2,4]-triazolo[1,5-a]pyridine

2-Benzylthio-6-bromo-8-methoxy[1,2,4]triazolo[1,5-a]pyridine (2.0 g, 5.7 mmol) was dissolved in dichloromethane (30 mL) in a three-necked flask equipped with high-speed stirrer and a dry ice condenser and was cooled in an ice bath to 5°C. Aqueous hydrochloric acid (2N, 30 mL, 60 mmol) and then sodium hypochlorite (5 percent aqueous solution, 50 mL, 34 mmol) were added with stirring. The mixture was allowed to react for 2 hours. The layers were then separated and

the aqueous layer was washed with dichloromethane (2x10 mL). The dichloromethane layer and wash were combined, washed with water (20 mL) and saturated aqueous sodium chloride solution (20 mL), and concentrated by evaporation under reduced pressure to obtain a gum. This was triturated with hexane to obtain 1.94 g (97 percent of theory) of the title compound as a yellow gum.

^{1}H NMR ($CDCl_3$): 7.14 (s, 1H); 4.13 (s, 3H).

34. Preparation of 2-Benzylthio-5,8-dichloro[1,2,4]triazolo[1,5-a]pyridine

A mixture of 9.9 g (0.10 mol) of copper(I) chloride with 300 mL of acetonitrile was prepared and 8.7 mL (6.8 g, 0.066 mol) of 90 percent t-butyl nitrite was added with stirring. After 10 minutes 9.5 g (0.033 mol) of 8-amino-2-benzylthio-5-chloro[1,2,4]triazolo[1,5-a]pyridine was added and the reaction mixture was allowed to react with stirring for 3 days. The mixture was then diluted with dichloromethane and 2N aqueous hydrochloric acid, and after mixing this well, the phases were separated. The organic layer was washed with 2N aqueous hydrochloric acid and concentrated by evaporation under reduced pressure. The residue was chromatographed on silica gel eluting with dichloromethane to obtain 6.5 g (63 percent of theory) of the title compound as a yellow powder melting at 103-104°C.

Elemental Analysis $C_{13}H_9Cl_2N_3S$

Calc.: %C, 50.3; %H, 2.92; %N, 13.6; %S, 10.3

Found: %C, 50.4; %H, 3.08; %N, 13.6; %S, 10.3

2-Benzylthio-8-chloro[1,2,4]triazolo[1,5-a]pyridine was prepared similarly from 8-amino-2-benzylthio[1,2,4]triazolo[1,5-a]pyridine. A 65 percent yield of this compound was obtained as a yellow powder melting at 82-83°C.

Elemental Analysis $C_{13}H_{10}ClN_3S$

Calc.: %C, 56.6; %H, 3.66; %N, 15.2; %S, 11.6

Found: %C, 56.6; %H, 3.33; %N, 15.3; %S, 11.5

35. Preparation of 2-Benzylthio-8-chloro-5-methoxy[1,2,4]triazolo[1,5-a]-pyridine

2-Benzylthio-5,8-dichloro[1,2,4]triazolo[1,5-a]pyridine (6.0 g, 0.019 mol) and 25 percent sodium methoxide in methanol (26.5 mL, 6.3 g, 0.116 mol) were combined in methanol and the mixture was heated to reflux for 2 hours. The mixture was then cooled, acidified with acetic acid, and concentrated by evaporation under reduced pressure. The residue was dissolved in dichloromethane and the solution was washed with water and

concentrated by evaporation under reduced pressure. The residue was triturated with hexane and the resulting solids were collected by filtration and dried to obtain 5.76 g (99 percent of theory) of the title compound as a light tan powder melting at 90-91°C.

Elemental Analysis $C_{14}H_{12}ClN_3OS$

Calc.: %C, 55.0; %H, 3.96; %N, 13.7; %S, 10.5

Found: %C, 54.9; %H, 4.02; %N, 13.4; %S, 10.7

36. Preparation of 2-Benzylthio-8-bromo-5-chloro[1,2,4]triazolo[1,5-a]-pyridine

Copper(I) bromide (4.9 g., 0.0034 mol) was combined with 200 mL of acetonitrile for 15 minutes and then 3.0 mL (2.3 g, 0.0023 mol) of 90 percent t-butyl nitrite was added and the mixture was stirred for a few minutes. 8-Amino-2-benzylthio-5-chloro[1,2,4]triazolo[1,5-a]pyridine (3.3 g, 0.0013 mol) was then added and the resulting mixture was stirred for 2 days. The resulting mixture was concentrated by evaporation under reduced pressure and the residue was chromatographed on silica gel eluting with dichloromethane. After the solvent of the product fractions was removed by evaporation under reduced pressure, the residue was mixed with hexane and the solid material was recovered by filtration and dried to obtain 2.6 g (56 percent of theory) of the title compound as a yellow powder melting at 122-124°C.

Elemental Analysis $C_{13}H_9BrClN_3S$

Calc.: %C, 44.0; %H, 2.56; %N, 11.9; %S, 9.04

Found: %C, 43.9; %H, 2.59; %N, 11.9; %S, 8.86

37. Preparation of 2-Benzylthio-8-bromo-5-methoxy[1,2,4]triazolo[1,5-a]-pyridine

2-Benzylthio-8-bromo-5-chloro[1,2,4]triazolo[1,5-a]pyridine (7.7 g, 0.0217 mol) and 25 percent sodium methoxide in methanol (19.9 mL, 4.7 g, 0.0868 mol) were mixed with 400 mL of methanol and the mixture was heated to reflux for 1.5 hours. It was then cooled and acidified with acetic acid. The volatiles were removed by evaporation under reduced pressure and the residue was dissolved in dichloromethane. The resulting solution was washed with water and concentrated by evaporation under reduced pressure. The resulting residue was triturated with hexane and the solids obtained were recovered by filtration and dried to obtain 7.3 g (96 percent of theory) of the title compound as a light tan powder melting at 78-79°C.

Elemental Analysis $C_{14}H_{12}BrN_3OS$

Calc.: %C, 48.0; %H, 3.45; %N, 12.0; %S, 9.16

Found: %C, 48.0; %H, 3.52; %N, 12.2; %S, 9.01

38. Preparation of N-(2,6-Difluorophenyl)-8-methoxy[1,2,4]triazolo[1,5-a]-pyridine-2-sulfonamide

N-(2,6-Difluorophenyl)-8-chloro[1,2,4]triazolo[1,5-a]pyridine--2-sulfonamide (0.8 g, 0.0023 mol) and 25 percent sodium methoxide in methanol (1.6 mL, 0.37 g, 0.007 mol) were combined with 20 mL of dimethyl sulfoxide and the resulting solution was stirred at ambient temperature overnight. Another 1.6 mL of 25 percent sodium methoxide in methanol was added and the reaction mixture was stirred another 3 days. The mixture was then acidified with acetic acid and diluted with dichloromethane. The resulting solution was washed well with water and concentrated by evaporation under reduced pressure. The residue, which appeared tc contain considerable starting material, was dissolved in 20 mL of dimethyl sulfoxide and potassium methoxide (0.4 g, 0.0057 mol) was added with stirring at ambient temperature. After about 3 hours the mixture was acidified with acetic acid and diluted with dichloromethane. The resulting solution was washed well with water and concentrated by evaporation under reduced pressure. The residue was mixed with hexane and the solids present were collected by filtration, washed with ether and with dichloromethane and dried to obtain 0.30 g (38 percent of theory) of the title compound as a white powder melting at 254-255°C.

Elemental Analysis $C_{13}H_{10}F_2N_4O_3S$

Calc.: %C, 45.9; %H, 2.96; %N, 16.5; %S, 9.42

Found: %C, 45.9; %H, 2.55; %N, 16.4; %S, 9.34

39. Preparation of 8-Amino-2-benzylthio-5,7-dibromo[1,2,4]triazolo[1,5-a]-pyridine

8-Amino-2-benzylthio[1,2,4]triazolo[1,5-a]pyridine (14.0 g, 0.055 mol) was dissolved in dichloromethane and N-bromosuccinimide (9.7 g., 0.055 mol) was added with stirring at ambient temperature. After 1 hour, another 6.0 g of N-bromosuccinimide was added. The mixture was allowed to stir overnight and was then washed well with dilute aqueous sodium bisulfite solution and with water and concentrated by evaporation under reduced pressure. The residue was chromatographed on silica gel eluting with 30 percent ethyl acetate in hexane to obtain 10.0 g (44 percent of theory) of the title compound as a dark gray powder melting at 116-118°C.

40. Preparation of 2-Benzylthio-7-bromo-5-methoxy[1,2,4]triazolo[1,5-a]-pyridine

2-Benzylthio-5,7-dibromo[1,2,4]triazolo[1,5-a]pyridine (11.6 g, 0.029 mol) and 25 percent sodium methoxide in methanol (13.0 mL, 3.1 g, 0.057 mol) were combined with 300 mL of acetonitrile and the mixture was heated to reflux with stirring for an hour. An additional 26 mL of 25 percent sodium methoxide in methanol was then added. After a 15-min reaction period, the mixture was acidified with acetic acid and the volatiles were removed by evaporation under reduced pressure. The residue was chromatographed on silica gel eluting with 20 percent ethyl acetate in hexane to obtain 4.97 g (49 percent of theory) of the title compound as a tan powder melting at 80-82°C.

Elemental Analysis $C_{14}H_{12}BrN_3OS$

Calc.: %C, 48.0; %H, 3.45; %N, 12.0; %S, 9.16

Found: %C, 48.2; %H, 3.42; %N, 11.9; %S, 9.24

41. Preparation of 3-Amino-2-fluoro-4-methylpyridine

To a solution of 10.1 g (65 mmol) of 2-fluoro-4-methyl-3--nitropyridine in 200 mL of ethyl acetate was added 25 g (0.40 mol) of acetic acid and 0.8 g of 5 percent palladium on carbon catalyst. This mixture was shaken under 50 psig (pounds per square inch gauge, 2400 kiloPascals) pressure of hydrogen for 18 hours, was filtered, and was concentrated by evaporation under reduced pressure to obtain an oil. This oil was partitioned between dilute aqueous sodium bicarbonate and ether. The organic phase was separated, dried over magnesium sulfate, and filtered. The filtrate was concentrated by evaporation under reduced pressure and the residue was purified by column chromatography to obtain 7.2 g (88 percent of theory) of the title compound as a colorless solid melting at 63-64°C.

Elemental Analysis $C_6H_7FN_2$

Calc.: %C, 57.1; %H, 5.59; %N, 22.2

Found: %C, 57.2; %H, 5.73; %N, 22.1

^1H NMR $CDCl_3$: 7.4 (d, 1H, J=5.0); 6.8 (d, 1H, J=5.0); 3.7 (br, 2H); 2.1 (s, 3H); ^{13}C NMR $CDCl_3$: 152.6 (d, J=229); 134.1 (d, J=8.6); 133.8 (d, J=14.5); 128.1 (d, J=27.1); 123.3, 16.4 (d, J=4.1).

3-Amino-2-fluoro-5-methylpyridine was prepared analogously from 2-fluoro-5--methyl-3-nitropyridine. This compound was obtained in 89 percent yield as white solid melting at 27-28.5°C.

Elemental Analysis $C_6H_7FN_2$

Calc.: %C, 57.1; %H, 5.59; %N, 22.2

Found: %C, 56.9; %H, 5.65; %N, 22.6

^1H NMR $CDCl_3$: 7.2 (d, 1H); 6.8 (d, 1H); 3.7 (br, 2H); 2.1 (s, 3H); ^{13}C NMR $CDCl_3$: 151.8 (d, J=229); 134.5 (d, J=12.6); 132.2 (d, J=3.9); 129.9 (d, J=28.7); 125.8 (d, J=5.3), 17.8.

42. Preparation of 3-Amino-2-chloro-4-methoxypyridine

To a solution of 6.4 g (51 mmol) of 3-amino-4-methoxypyridine in 30 mL of 37 percent aqueous hydrochloric acid was slowly added 7.8 g of 30 percent aqueous hydrogen peroxide at room temperature with stirring. After 30 min this solution was slowly poured into 300 mL of saturated aqueous sodium bicarbonate and the resulting mixture was extracted with ether (3 x 200 mL). The ethereal extracts were combined, dried over magnesium sulfate, and filtered. The filtrate was concentrated by evaporation under reduced pressure to obtain a light brown solid. This solid was purified by column chromatography eluting with 17:83 acetone:hexane to obtain 6.54 g (81 percent of theory) of the title compound as colorless needles melting at 86-87°C.

Elemental Analysis $C_6H_7ClN_2O$

Calc.: %C, 45.4; %H, 4.45; %N, 17.7

Found: %C, 45.4; %H, 4.65; %N, 17.8

^1H NMR $CDCl_3$: 7.7 (d, 1H, J=5.4), 6.6 (d, 1H, J=5.4), 4.0 (br, 2H), 3.8 (s, 3H); ^{13}C NMR $CDCl_3$: 153.3, 138.5, 135.6, 129.9, 105.2, 55.9.

3-Amino-2-chloro-4-ethoxypyridine was prepared from 3-amino-4-ethoxypyridine in an analogous procedure and was obtained as a white solid melting at 72-73°C.

Elemental Analysis $C_7H_9ClN_2O$

Calc.: %C, 48.7; %H, 5.26; %N, 16.2

Found: %C, 48.9; %H, 4.98; %N, 16.5

^1H NMR $CDCl_3$: 7.7 (d, 1H, J=5.4), 6.6 (d, 1H, J=5.4), 4.1 (q, 2H, J=7.0), 4.0 (br, 2H), 1.5 (t, 3H, J=7.0).

3-Amino-2-chloro-4-propoxypyridine was prepared from 3-amino-4-propoxypyridine in an analogous procedure and was obtained as a white solid melting at 46-47°C.

Elemental Analysis $C_8H_{11}ClN_2O$

Calc.: %C, 51.5; %H, 5.94; %N, 15.0

Found: %C, 51.8; %H, 5.97; %N, 15.2

^1H NMR $CDCl_3$: 7.7 (d, 1H, J=5.4), 6.6 (d, 1H, J=5.4), 4.1 (br, 2H), 4.0 (t, 2H, J=6.5), 1.84 (m, 2H), 1.0 (t, 3H, J=7.4).

3-Amino-2-chloro-4-(1-methylethoxy)pyridine was prepared from 3-amino-4--(1-methylethoxy)pyridine in an analogous procedure and was obtained as an amber oil.

Elemental Analysis $C_8H_{11}ClN_2O$

Calc.: %C, 51.5; %H, 5.94; %N, 15.0

Found: %C, 51.1; %H, 5.87; %N, 15.4

^1H NMR $CDCl_3$: 7.7 (d, 1H, J=5.5), 6.6 (d, 1H, J=5.4), 4.6 (m, 1H, J=6.0), 4.0 (br, 2H), 1.34 (d, 6H, J=6.0).

43. Preparation of 3-Amino-2-ethylthio-4-methylpyridine

2-Ethylthio-4-methyl-3-nitropyridine (10.0 g, 50.4 mmol) was added slowly with stirring to a solution of 57 g (0.25 mole) of stannous chloride in 250 mL of concentrated aqueous hydrochloric acid. An exothermic reaction took place. The solution was held at 70°C for 30 min, cooled, and then poured slowly into saturated aqueous sodium bicarbonate solution. The resulting mixture was extracted with ether and the extract was dried over magnesium sulfate, filtered, and concentrated by evaporation under reduced pressure to obtain 5.8 g (68 percent of theory) of a light yellow oil that solidified upon standing. This solid was recrystallized from hexane to obtain 3.2 g of the title compound as a white solid melting at 37-38°C.

Elemental Analysis $C_8H_{12}N_2S$

Calc.: %C, 57.1; %H, 7.19; %N, 16.7; %S, 19.1

Found: %C, 57.3; %H, 6.88; %N, 16.8; %S, 19.0

^1H NMR $CDCl_3$: 7.8 (d, 1H, J=4.8), 6.7 (d, 1H, J=4.8), 3.8 (br, 2H), 3.2 (q, 2H, J=7.4), 2.1 (s, 3H), 1.3 (t, 3H, J=7.4); ^{13}C NMR $CDCl_3$: 142.2, 139.5, 139.3, 128.9, 122.4, 25.4, 17.0, 15.0.

44. Preparation of Methyl 3-Amino-2-chloroisonicotinate

A mixture of 18 g (118 mmol) of methyl 3-aminoisonicotinate and 12 g (60 mmol) of 1,3-dichloro-5,5-dimethylhydantoin in 1500 mL of tetrachloroethylene was warmed slowly to 80°C with stirring and held there for 3 hours. The solution was then cooled, filtered, washed with dilute aqueous sodium bicarbonate, dried over magnesium sulfate, filtered, and concentrated by evaporation under reduced pressure to obtain a dark oil. This oil was purified by careful column chromatography to obtain 8.7 g (30 percent of theory) of the title compound as a colorless solid melting at 91-92°C.

Elemental Analysis $C_7H_7ClN_2O_2$

Calc.: %C, 45.1; %H, 3.78; %N, 15.0

Found: %C, 45.2; %H, 3.94; %N, 15.1

^1H NMR $CDCl_3$: 7.7 (d, 1H, J=5.1); 7.6 (d, 1H, J=5.1); 6.2 (br, 2H); 3.9 (s, 3H); ^{13}C NMR $CDCl_3$: 166.7, 141.9, 139.0, 134.7, 122.8, 116.5, 52.3.

45. Preparation of 3-Amino-4-ethyl-2-fluoropyridine

Trimethylsilyl chloride (2.2 g, (0.18 mmol) and sodium iodide (2.7 g, 0.18 mmol) were added to a solution of 3.6 g (0.15 mmol) of t-butyl N-(4-ethyl-2-fluoro-3-pyridyl)carbamate in 50 mL of dry acetonitrile with stirring at ambient temperature. After 2 hours the mixture was poured into ether and the resulting solution was washed with dilute aqueous sodium bisulfite, dried over magnesium sulfate, and filtered. The filtrate was concentrated by evaporation under reduced pressure to obtain an oil. This oil was purified by column chromatography to obtain 1.6 g (76 percent of theory) of the title compound as a gold oil.

Elemental Analysis $C_7H_9FN_2$

Calc.: %C, 60.0; %H, 6.47; %N, 20.0

Found: %C, 59.8; %H, 6.66; %N, 20.2

^1H NMR $CDCl_3$: 7.4 (d, 1H, J=5.0); 6.8 (d, 1H, J=5.0); 3.7 (br, 2H); 2.45 (q, 2H, J=7.5); 1.2 (t, 3H, J=7.5).

3-Amino-4-(1-methylethyl)-2-fluoropyridine was prepared in an analogous way from t-butyl N-(4-(1-methylethyl)-2-fluoro-3-pyridyl)carbamate. This compound was obtained in 92 percent yield as a gold oil.

Elemental Analysis $C_8H_{11}FN_2$

Calc.: %C, 62.3; %H, 7.19; %N, 12.3

Found: %C, 62.5; %H, 7.24; %N, 12.6

^1H NMR $CDCl_3$: 7.4 (d, 1H, J=5.2); 6.8 (d, 1H, J=5.1); 3.8 (br, 2H); 2.87 (m, 1H); 1.2 (d, 6H, J=6.8).

46. Preparation of t-Butyl N-(4-Ethyl-2-fluoro-3-pyridyl)carbamate

A solution of lithium diisopropylamine (LDA) was prepared from 19.3 mL (137 mmol) of diisopropylamine and 55 mL (137 mmol) of 2.5 M n-butyllithium in hexane in 250 mL of dry tetrahydrofuran at -20°C. A solution of 14.4 g (62.5 mmol) of t-butyl N-(4-methyl-2-fluoro-3-pyridyl)-carbamate in 80 mL of dry tetrahydrofuran was added dropwise with stirring at a rate slow enough to maintain the temperature below -60°C. After a 30-min reaction period, 27 g (190 mmol) of methyl iodide was added and the solution was allowed to warm to -10°C. The resulting mixture was diluted with 100 mL of aqueous ammonium chloride and 200 mL of ether and the phases

were separated. The aqueous phase was washed with ether (3 x 100 mL). The organic phase and washes were combined, dried over magnesium sulfate, and filtered. The filtrate was concentrated by evaporation under reduced pressure to obtain a gold oil. This oil was purified by column chromatography to obtain 11.4 g (76 percent of theory) of the title compound as a white solid melting at 84-86°C.

^{1}H NMR $CDCl_3$: 7.7 (d, 1H, J=5.08); 6.8 (d, 1H, J=5.08); 6.1 (br, 1H); 2.45 (q, 2H, J=7.6); 1.2 (s, 9H); 1.0 (t, 3H, J=7.6).

t-Butyl N-(4-(1-methylethyl)-2-fluoro-3-pyridyl)carbamate was prepared analogously from t-butyl N-(4-ethyl-2-fluoro-3-pyridyl)carbamate. This compound was obtained in 69 percent yield as a colorless solid melting at 60-62°C.

Elemental Analysis $C_{13}H_{19}FN_2O_2$

Calc.: %C, 61.4; %H, 7.53; %N, 11.0

Found: %C, 61.6; %H, 7.78; %N, 11.3

^{1}H NMR $CDCl_3$: 7.9 (d, 1H, J=5.4); 7.0 (d, 1H, J=5.4); 6.0 (br, 1H); 3.2 (m, 1H); 1.4 (s, 9H); 1.2 (d, 6H, J=5.2).

47. Preparation of 3-Amino-2,4,5-trichloropyridine

Thirty percent aqueous hydrogen peroxide (3.0 g, 26 mmol) was added dropwise with stirring at 15°C to a solution of 8.0 g (49 mmol) of 3-amino-4,5-dichloropyridine in 450 mL of 37 percent aqueous hydrochloric acid. After 30 min another 2.6 g (23 mmol) of 30 percent aqueous hydrogen peroxide was added and the solution was allowed to slowly warm to room temperature. The resulting mixture was diluted with water, neutralized with sodium carbonate, and extracted with ether. The ethereal extract was dried over magnesium sulfate and filtered. The filtrate was concentrated by evaporation under reduced pressure to obtain a viscous oil. This oil was partially purified by chromatography to obtain 2.5 g (26 percent of theory) of the title compound, a white solid melting at 88-90°C, and 5.3 g of a mixture of the title compound and 3-amino-2,4,5,6-tetrachloropyridine.

Elemental Analysis $C_5H_3Cl_3N_2$

Calc.: %C, 30.4; %H, 1.53; %N, 14.2

Found: %C, 30.5; %H, 1.47; %N, 14.1

^{1}H NMR $CDCl_3$: 7.7 (s, 1H); 4.6 (br, 2H).

48. Preparation of 3-Amino-4-fluoro-2-methoxypyridine

A solution 5.0 g (26.2 mmol) of p-toluenesulfonic acid monohydrate in 150 mL of toluene was refluxed to azeotropically remove the water and was then allowed to cool. A 5.0 g (20.6 mmol) amount of t-butyl

N-(4-fluoro-2-methoxy-3-pyridyl)carbamate was added and the solution was heated to reflux with stirring for 5 min. The mixture was cooled and the liquid was removed by decantation. The solid residue was partitioned between ether and saturated aqueous sodium carbonate and the organic phase was recovered, dried over magnesium sulfate, filtered, and concentrated by evaporation. The residue was purified by flash chromatography to obtain 2.7 g (91 percent of theory) of the title compound as a near-clear oil.
Elemental Analysis $C_6H_7FN_2O$

Calc.: %C, 50.7; %H, 4.96; %N, 19.7

Found: %C, 50.9; %H, 5.26; %N, 19.1

^{1}HNMR ($CDCl_3$): 7.5 (dd, 1H, j=5.7, 7.8); 6.6 (dd, 1H, j=5.7, 9.4); 3.9 (s, 3H); 3.7 (br, 2H).

49. Preparation of t-Butyl N-(4-Fluoro-2-methoxy-3-pyridinyl)carbamate

To a solution of 8 g (35.7 mmol) of t-butyl N-(2-methoxy-3-pyridyl)carbamate in 200 mL of dry tetrahydrofuran was added with stirring at -60°C, 46.2 mL (78.5 mmol) of 1.7 M t-butyl lithium in pentane. The resulting solution was allowed to warm slowly with stirring to -20°C over a 20 to 30 min period. It was then cooled to about -60°C and 12.2 g (38.7 mmol) of N-fluorodibenzenesulfonimide was added with stirring all at once. The mixture was allowed to warm to -20°C and was poured into 500 mL of ether. The resulting ethereal solution was washed with a mixture of 2.5 g (41.7 mmol) of acetic acid and 150 mL of water. The aqueous phase was extracted with 200 mL of ether. The ethereal extracts were combined, dried over magnesium sulfate, filtered, and concentrated by evaporation. The residue was purified by flash chromatography to obtain 6.7 g (77 percent of theory) of the title compound as a colorless solid melting at 75-77°C.
Elemental Analysis $C_{11}H_{15}FN_2O_3$

Calc.: %C, 54.5; %H, 6.24; %N, 11.6

Found: %C, 54.2; %H, 6.39; %N, 11.4

^{1}H NMR ($CDCl_3$): 7.88 (dd, 1H, j=5.8, 7.6); 6.68 (dd, 1H, j=5.8, 8.9); 5.9 (br, 1H); 3.9 (s, 3H); 1.45 (s, 9H).

50. Preparation of Methyl 3-Amino-2-ethoxyisonicotinate

A solution 7.5 g (39.4 mmol) of p-toluenesulfonic acid monohydrate in 150 mL of toluene was refluxed to azeotropically remove the water. The mixture was allowed to cool and then 11.0 g (37.1 mmol) of t-butyl N-(4-carboxymethyl-2-ethoxy-3-pyridyl)carbamate was added with stirring and the solution was heated to 95°C for 15 min. The resulting mixture was cooled and the liquid was removed by decantation.

The solid residue was partitioned between ether and saturated aqueous sodium carbonate. The organic phase was recovered, dried over magnesium sulfate, filtered, and concentrated by evaporation. The residue was purified by column chromatography to obtain 6.4 g (88 percent of theory) of the title compound as a light yellow solid melting at 59-60.5°C.

Elemental Analysis $C_9H_{12}N_2O_3$

Calc.: %C, 55.1; %H, 6.16; %N, 14.3

Found: %C, 54.6; %H, 6.00; %N, 14.5

^1H NMR ($CDCl_3$): 7.3 (d, 1H, j= 5.6); 7.1 (d, 1H, j=5.6); 5.9 (br, 2H); 4.3 (q, 2H, j=7.1); 3.8 (s, 3H); 1.37 (t, 3H, j= 7.1).

Methyl 3-amino-2-methoxyisonicotinate, an amber oil, was prepared analogously.

Elemental Analysis $C_8H_{10}N_2O_3$

Calc.: %C, 50.0; %H, 4.80; %N, 16.7

Found: %C, 50.2; %H, 5.26; %N, 16.6

^1H NMR ($CDCl_3$): 7.3 (d, 1H, j=5.6); 7.1 (d, 1H, j=5.6); 5.9 (br, 2H); 3.96 (s, 3H); 3.8 (s, 3H).

Ethyl 3-amino-2-methoxyisonicotinate, a light yellow oil, was prepared analogously.

Elemental Analysis $C_9H_{12}N_2O$

Calc.: %C, 55.1; %H, 6.16; %N, 14.3

Found: %C, 54.2; %H, 6,56; %N, 14.6

^1H NMR ($CDCl_3$): 7.3 (d, 1H, j=5.6); 7.1 (d, 1H, j=5.6); 5.9 (br, 2H); 4.28 (q, 2H, j=7.2); 3.9 (s, 3H); 1.33 (t, 3H, j=7.14).

51. Preparation of t-Butyl N-(4-Carboxymethyl-2-ethoxy-3-pyridinyl-carbamate

To a solution of 12.0 g (50.3 mmol) of t-butyl N-(2-ethoxy--3-pyridinyl)carbamate in 200 mL of dry tetrahydrofuran was added with stirring at -50°C, 66 mL (111 mmol) of 1.7 M t-butyl lithium in pentane. The resulting solution was allowed to warm slowly to 0°C over a 20 to 30 min. period and was then cooled to -60°C and poured into 500 mL of ether saturated with crushed dry ice (carbon dioxide). The resulting mixture was acidified at room temperture with 3.0 g (50 mmol) of acetic acid and the fine white solid precipitate that formed was collected by filtration and dried under reduced pressure at 50°C to obtain 17.0 g of a lithium salt containing some tetrahydrofuran. This

salt was combined with 30.0 g (211 mmol) of iodomethane in 150 mL of dry dimethyl sulfoxide and the mixture was stirred for 1 hr. It was then poured into 400 mL of water. The aqueous mixture was extracted with 500 then 200 mL of ether. The ether extracts were combined, dried over magnesium sulfate, filtered, and concentrated by evaporation. The residue was purified by column chromatography to obtain 11.5 g (77 percent of theory) of the title compound as a colorless solid melting at 94-95.5°C.

Elemental Analysis $C_{14}H_{20}N_2O_5$

Calc.: %C, 56.8; %H, 6.80; %N, 9.45

Found: %C, 56.8; %H, 7.00; %N, 9.63

^{1}H NMR ($CDCl_3$): 7.8 (d, 1H, j=5.3); 7.1 (d, 1H, j=5.3); 6.9 (br, 1H); 4.4 (q, 2H, j=7.0); 3.8 (s, 3H); 1.46 (s, 9H); 1.37 (t, 3H, j=7.0).

t-Butyl N-(4-carboxyethyl-2-methoxy-3-pyridinyl)carbamate, a colorless solid melting at 40-41°C, was prepared analogously.

Elemental Analysis $C_{14}H_{20}N_2O_5$

Calc.: %C, 56.8; %H, 6.80; %N, 9.45

Found: %C, 56.6; %H, 6.76;% N, 9.26

^{1}H NMR ($CDCl_3$): 7.9 (d, 1H, j=5.3); 7.1 (d, 1H, j=5.25); 6.9 (br, 1H); 4.27 (q, 2H, j=7.15); 3.96 (s, 3H); 1.45 (s, 9H); 1.33 (t, 3H, j=7.14).

t-Butyl N-(4-Carboxymethyl-2-methoxy-3-pyridinyl)carbamate, a colorless solid melting at 107-108°C, was obtained analogously.

Elemental Analysis $C_{13}H_{18}N_2O_5$

Calc.: %C, 55.3; %H, 6.43; %N, 9.92

Found: %C, 55.5; %H, 6.22; %N, 10.1

^{1}H NMR ($CDCl_3$): 7.9 (d, 1H, j=5.3); 7.1 (d, 1H, j=5.4); 6.9 (br, 1H); 3.97 (s, 3H); 1.46 (s, 9H).

52. Preparation of t-Butyl N-(4-Chloro-2-ethoxy-3-pyridinyl)carbamate

To a solution of 15 g (63 mmol) of t-butyl N-(2-ethoxy-3--pyridinyl)carbamate in 175 mL of dry tetrahydrofuran was added with stirring at -60°C, 78 mL (132 mmol) of 1.7 M t-butyl lithium in pentane. The resulting solution was allowed to warm to -10°C over a 30 min. period and was then cooled to -60°C. A A 22.3 g (94 mmol) amount of hexachoroethane was added all at once with stirring and the mixture are allowed to warm to ambient temperature. It was then diluted with 600 mL of ether and the resulting solution was washed with 150 mL of water, dried over magnesium sulfate, filtered, and concentrated by

evaporation. The residue was purified by column chromatography to obtain 11.1 g (65 percent of theory) of the title compound as a colorless solid melting at 73-74°C. Elemental Analysis $C_{12}H_{17}ClN_2O_3$:

Calc.: %C, 52.9; %H, 6.28; %N, 10.3

Found: %C, 53.0; %H, 6.30; %N, 10.3

^1H NMR ($CDCl_3$): 7.88 (d, 1H, j=5.5); 6.93 (d, 1H, j=5.5); 6.0 (br, 1H); 4.4 (q, 2H, j=7.0); 1.5 (s, 9H); 1.39 (t, 3H, j=7.0.).

53. Preparation of t-Butyl N-(2-Ethoxy-3-pyridinyl)carbamate

To a solution of 38.1 g (0.28 mol) of 3-amino-2-ethoxy-pyridine in 400 mL of dry dioxane was added with stirring 60 g (0.28 mol) of di-t-butyl dicarbonate and the solution was slowly heated to reflux over a 4 hr period. The resulting solution was cooled below reflux and another 5.0 g (23 mmol) of di-t-butyl dicarbonate was added with stirring the the mixture was reheat at reflux for 1 hr. The volatiles were removed by evaporation under reduced pressure and the residue obtained was purified by column chromatography to obtain 58.3 g (89 percent of theory) of the title compound as a colorless oil. Elemental Analysis $C_{12}H_{18}N_2O_3$

Calc.: %C, 60.5; %H, 7.61; %N, 11.8

Found: %C, 59.7; %H, 9.03; %N, 11.9

^1H NMR ($CDCl_3$): 8.2 (broad d, 1H, j=7.0); 7.7 (d, 1H, j=5.0); 6.9 (br, 1H); 6.8 (dd, 1H, j=5.0, 5.0), 4.4 (q, 2H, j=7.1); 1.47 (s, 9H); 1.36 (t, 3H, j=7.1).

54. Preparation of 3-Amino-4-ethoxy-2-fluoropyridine

To a solution of 19 g (74 mmol) of t-butyl N-(4-ethoxy-2-fluoro--3-pyridinyl)carbamate and 12.2 g (81.5 mmol) of sodium iodide in 400 mL of dry acetonitrile was added with stirring 8.9 g (81.5 mmol) of trimethylsilyl chloride. The mixture was allowed to react for 4 hr and then a 100 mL solution of aqueous sodium bicarbonate was added with stirring. The resulting mixture was extracted with 1 L of ether and the ether extract was dried over magnesium sulfate, filtered, and concentrated by evaporation. The residue was purified by column chromatography to obtain 6.3 g (55 percent of theory) of the title compound as a colorless solid melting at 76-77°C.

Elemental Analysis $C_7H_9FN_2O$

Calc.: %C, 53.5; %H, 5.81; %N, 17.9

Found: %C, 54.3; %H, 6.44; %N, 17.7

^{1}H NMR ($CDCl_3$): 7.5 (d, 1H, j=5.74); 6.5 (d, 1H, j=5.64); 4.1 (q, 2H, j=7.0); 3.6 (br, 2H); 1.4 (t, 3H, j=6.9).

3-Amino-2-fluoro-4-methoxypyridine, a colorless solid melting at 48-50°C, was prepared analogously.

Elemental Analysis $C_6H_7FN_2O$

Calc.: %C, 50.7; %H, 4.96; %N, 19.7

Found: %C, 50.9; %H, 5.13; %N, 19.9

^{1}H NMR ($CDCl_3$): 7.5 (d, 1H, j=5.57); 6.63 (d, 1H, j=5.47); 3.8 (s, 3H); 3.7 (br, 2H).

3-Amino-2-fluoro-4-propoxypyridine, a colorless oil, was prepared analogously.

Elemental Analysis $C_8H_{11}FN_2O$

Calc.: %C, 55.5; %H, 6.51; %N, 16.5

Found: %C, 56.7; %H, 6.66; %N, 16.2

^{1}H NMR ($CDCl_3$): 7.4 (d, 1H, j=5.61); 6.5 (d, 1H, j=5.71); 4.5 (t, 2H, j= 6.5); 3.7 (br, 2H); 1.8 (m, 2H, j=7.3); 1.0 (t, 3H, j=7.4).

3-Amino-2-fluoro-4-(1-methylethoxy)pyridine, a gold oil, was prepared analogously.

Elemental Analysis $C_8H_{11}FN_2O$

Calc.: %C, 55.5; %H, 6.51; %N, 16.5

Found: %C, 56.9; %H, 6.69; %N, 16.4

^{1}H NMR ($CDCl_3$): 7.5 (d, 1H, j=5.57); 6.6 (d, 1H, j=5.71); 4.5 (m, 1H, j=6.1); 3.6 (br, 2H); 1.3 (d, 6H, j=6.1).

55. Preparation of t-Butyl N-(4-ethoxy-2-fluoro-3-pyridinyl)carbamate

To a solution of 18.5 g (131 mmol) of 4-ethoxy-2--fluoropyridine in 300 mL of dry tetrahydrofuran at -78°C was added slowly, with stirring and cooling to maintain the temperture below -65°C, 58 mL of 2.5 M butyl lithium in hexane. The mixture was allowed to react for 1 hr and then the resulting slurry was poured into 1300 mL of ether containing excess powdered dry ice (carbon dioxide). The fine white precipitate that formed was collected by filtration and dried under reduced pressure for 90 min. The hygroscopic solid obtained was taken into 700 mL of t-butanol and 68 g (0.24 mol) of diphenyl phosphoryl azide was added with stirring. This mixture was slowly warmed to reflux for 2 hr during which time there was a vigorous evolution of nitrogen. The resulting slurry was filtered and the filtrate was diluted with 800 mL of dichloromethane. The organic phase

was separated, washed with water (2 x 100 mL), and concentrated by evaporation to obtain a semi-solid residue. This was dissolved in fresh dichloromethane and the solution was dried over magnesium sulfate, filtered, and concentrated by evaporation. The residue was purified by column chromatography to obtain 19.5 g (63 percent of theory) of the title compound as a colorless solid melting at 130-131°C. Elemental Analysis $C_{12}H_{17}FN_2O_3$

Calc.: %C, 56.2; %H, 6.69; %N, 10.9

Found: %C, 56.1; %H, 6.99; %N, 11.3

^1H NMR ($CDCl_3$): 7.85 (d, 1H, j=5.7); 6.6 (d, 1H, j=5.7); 6.0 (br, 1H); 4.1 (q, 2H, j=7.0); 1.4 (t, 3H, j=6.9); 1.35 (t, 3H, j=7.0).

t-Butyl N-(2-fluoro-4-(1-methylethoxy)-3-pyridinyl)carbamate, a colorless solid melting at 80-81.5°C, was obtained analogously. Elemental Analysis $C_{13}H_{19}FN_2O_3$

Calc.: %C, 57.8; %H, 7.09; %N, 10.4

Found: %C, 57.9; %H, 6.94; %N, 10.7

^1H NMR ($CDCl_3$): 7.9 (d, 1H, j=5.9); 6.7 (d, 1H, j=5.96); 6.0 (br, 1H); 4.6 (m, 1H, j=6.1); 1.45 (s, 9H); 1.35 (d, 6H, j=6.1).

t-Butyl N-(2-fluoro-4-propoxy-3-pyridinyl)carbamate, a colorless solid melting at 84-86°C, was obtained analogously. Elemental Analysis $C_{13}H_{19}FN_2O_3$

Calc.: %C, 57.8; %H, 7.09; %N, 10.4

Found: %C, 57.8; %H, 7.37; %N, 10.5

^1H NMR ($CDCl_3$): 7.9 (d, 1H, j=5.8); 6.7 (d, 1H, j=5.8); 5.8 (br, 1H); 4.0 (t, 2H, j=6.5); 1.83 (m, 2H, j=7.36); 1.46 (s, 9H); 1.0 (t, 3H, j=7.5).

56. Preparation of 4-Ethoxy-2-fluoropyridine

To a solution of 60.5 g (0.31 mol) of 3,5-dichloro-4--ethoxy-2-fluoropyridine and 32.2 g (0.32 mol) of sodium acetate in 400 mL of ethanol in a 1 L stirred steel Parr bomb was added 3 g of 5 percent palladium on carbon catalyst. The reactor was charged with 500 pounds per square inch gauge (3550 kiloPascals) of hydrogen and heated with stirring to 100°C for 4 hr. The mixture was cooled, filtered, and concentrated by evaporation. The residue was dissolved in ether and the resulting solution was dried over magnesium sulfate, filtered, and concentrated by evaporation. The residue was purified by bulb to bulb distillation (60-80°C at 0.5 mm Hg (67 Pascals) to obtain 18.5 g (42 percent of theory) of the title compound as a colorless oil which

solidified upon standing and melted at 35-36°C.
Elemental Analysis C_7H_8NO
Calc.: %C, 59.6; %H, 5.71; %N, 9.92
Found: %C, 59.2; %H, 5.97; %N, 9.95
^1H NMR ($CDCl_3$): 7.9 (d, 1H, j=5.8); 6.6 (m, 1H); 6.3 (d, 1H, j=2.2); 4.0 (q, 2H, j=7.0); 1.4 (t, 3H, j=7.0).

2-Fluoro-4-methoxypyridine, a colorless oil boiling at 119-122°C at 30 mm Hg (4.0 kiloPascals), was prepared analogously.
Elemental Analysis C_6H_6FNO
Calc.: %C, 59.6; %H, 5.71; %N, 9.92
Found: %C, 59.2; %H, 5.97; %N, 9.95
^1H NMR ($CDCl_3$): 8.0 (d, 1H, j=5.9); 6.7 (m, 1H); 6.4 (d, 1H, j=2.1); 3.9 (s, 3H).

2-Fluoro-4-(1-methylethoxy)pyridine, a colorless oil, was obtained analogously.
Elemental Analysis $C_8H_{10}FNO$
Calc.: %C, 61.9; %H, 6.50; %N, 9.03
Found: %C, 61.5; %H, 6.59; %N, 9.32
^1H NMR ($CDCl_3$): 8.0 (d, 1H, j=5.9); 6.6 (dd, 1H, j=4.5, 1.4); 6.33 (d, 1H, j=2.0); 4.0 (t, 2H, j=6.6); 1.8 (m, 2H, j=7.3); 1.0 (t, 3H, j=7.3).

2-Fluoro-4-propoxypyridine, a colorless oil, was obtained analogously.
Elemental Analysis $C_8H_{10}FNO$
Calc.: %C, 61.9; %H, 6.50; %N, 9.03
Found: %C, 61.0; %H, 7.50; %N, 9.09
^1H NMR ($CDCl_3$): 8.0 (d, 1H, j=5.9); 6.6 (m, 1H); 6.3 (d, 1H, j=2.2); 4.57 (m, 1H, j=6.1); 1.3 (d, 6H, j=6.1).

57. Preparation of 3,5-Dichloro-4-ethoxy-2-fluoropyridine

To a solution of 70.2 g (0.38 mol) of 3,5-dichloro-2,4--difluoropyridine in 600 mL of ethanol was slowly added with stirring a solution of sodium ethoxide in ethanol prepared from 16 g (0.40 mol) of sodium hydride (60 percent in mineral oil, hexane washed) in 200 mL of ethanol. The mixture was allowed to stir overnight and the brown solution obtained was filtered through powdered cellulose and concentrated by evaporation under reduced pressure. The residue was partitioned between 500 mL of ether and 400 mL of water. The organic phase was recovered, dried over magnesium sulfate, filtered, and concentrated by evaporation. The residue was distilled to obtain 62 g

(84 percent of theory) of the title compound as a colorless oil having a boiling point of 175-180°C at 0.4 mm Hg (53 Pascals).

Elemental Analysis $C_7H_6Cl_2FN$

Calc.: %C, 43.3; %H, 3.12; %N, 7.22

Found: %C, 40.0; %H, 2.92; %N, 6.66

^1H NMR ($CDCl_3$): 8.04 (s, 1H); 4.3 (q, 2H, j=7.0); 1.48 (t, 3H, j=7.1).

3,5-Dichloro-2-fluoro-4-methoxypyridine, a colorless oil, was obtained analogously.

^1H NMR ($CDCl_3$): 8.1 (s, 1H); 4.88 (m, 1H, j=6.1); 1.4 (d, 6H, j=6.1).

3,5-Dichloro-2-fluoro-4-(1-methylethoxy)pyridine, a colorless oil, was obtained analogously.

^1H NMR ($CDCl_3$): 8.0 (s, 1H); 4.88 (m, 1H, j=6.1); 1.4 (d, 6H, j=6.1).

3,5-Dichloro-2-fluoro-4-propoxypyridine, a colorless oil, was obtained analogously.

^1H NMR ($CDCl_3$): 8.1 (s, 1H); 4.2 (t, 2H, j=6.7); 1.86 (m, 2H, j=7.1); 1.1 (t, 3H, j=7.3).

58. Preparation of 3-Amino-4-fluoro-1-methylindazole

Methylhydrazine (4.96 g, 108 mmol was added to a solution of 15.0 g (108 mmol) of 2,6-difluorobenzonitrile in 150 mL of ethanol and the mixture was heated to reflux with stirring for 72 hours. The volatiles were then removed by evaporation under reduced pressure and the residue was dissolved in dichloromethane. The resulting solution was washed with water, dried over magnesium sulfate, and evaporated to dryness under reduced pressure to obtain the title compound as a white solid. This was recrystallized from ethanol to obtain 10.1 g (57 percent of theory) of the title compound as white crystals melting at 125-127°C.

Elemental Analysis $C_8H_8FN_3$

Calc.: %C, 58.2; %H, 4.88; %N, 25.4

Found: %C, 58.7; %H, 4.76; %N, 25.9

^1H NMR $CDCl_3$: 7.19 (m, 1H), 7.11 (d, 1H, J=8.4), 6.59 (d of d, 1H, J=8.4, 3.3), 5.26 (brs, 2H), 3.72 (s, 3H); ^{13}C NMR $CDCl_3$: 157.35, 154.88, 146.20, 146.18, 143.85, 143.76, 127.62, 127.55, 105.31, 105.27, 103.44, 103.24, 101.96, 101.78, 34.74.

59. Preparation of 3-Amino-1-methyl-4-(trifluoromethylthio)pyrazole

Trifluoromethanesulfenyl chloride (11.6 g, 85.0 mmol) was added

to a solution of 3-amino-1-methylpyrazole (8.0 g, 82.4 mmol) in 150 mL of dichloromethane with stirring at a rate such that the temperature did not rise above 5°C. When the addition was complete the mixture was allowed to warm to ambient temperature and stir for 18 hours and was then purged with nitrogen gas for 1 hour to remove any unreacted trifluoromethanesulfenyl chloride. The solid that formed during the reaction was collected by filtration and the filtrate was concentrated by evaporation under reduced pressure to obtain additional solids. The combined solids were dissolved in water and the solution was basified with 1N aqueous sodium hydroxide. The resulting mixture was extracted with dichloromethane (2x100 mL) and the extracts were combined, dried over magnesium sulfate, and filtered. The filtrate was concentrated by evaporation under reduced pressure to obtain a solid residue that appeared to be a mixture of two compounds. This solid was recrystalized from methylcyclohexane to obtain 16.2 g (40 percent of theory) of the title compound as a yellow solid melting at 138-140°C. The impurity was identified as 1-methyl-3-((trifluoromethanesulfenyl)amino)-4-(trifluoromethythio)pyrazole.

Elemental Analysis $C_5H_6F_3N_3S$

Calc.: %C, 30.5; %H, 3.07; %N, 21.3; %S, 16.3

Found: %C, 30.5; %H, 2.87; %N, 21.1; %S, 16.5

^1H ($CDCl_3$): 7.31 (s, 1H), 4.00 (brs, 2H), 3.68 (s, 3H);

^{13}C ($CDCl_3$): 157.47, 137.04, 133.61, 130.52, 127.44, 124.35, 84.23, 38.97.

60. Preparation of Methyl 6-Chloro-3-methoxypicolinate and Methyl 3-Chloro-6-methoxypicolinate

Sodium methoxide in methanol (100 mL of 25 percent, 22.8 g, 0.42 mol) was added to a solution of methyl 3,6-dichloropicolinate (44.0 g, 0.21 mol) in acetonitrile (400 mL) and the resulting solution was stirred at room temperature for 3.5 hours. The reaction mixture was acidified with acetic acid and the solvent was removed by evaporation. The residue obtained was mixed with dichloromethane and washed sequentially with water, dilute aqueous sodium hydroxide, and dilute aqueous hydrochloric acid. The organic solvent was removed by evaporation and the residue obtained was purified by column chromatography on silica gel, eluting with 20 percent ethyl acetate in hexane until the methyl 3-chloro-6-methoxypicolinate desorbed and then with 25 percent ethyl acetate in hexane until the methyl 6-chloro-3-methoxypicolinate desorbed. Methyl 3-chloro-6-methoxypicolinate (23.4 g) was recovered as a white powder melting at 38-39°C and the methyl 6-chloro-3-methoxypicolinate (8.5 g) was recovered as a white powder melting at 81-82°C.

61. Preparation of 6-Chloro-3-methoxypicolinamide.

Methyl 6-chloro-3-methoxypicolinate (8.0 g, 40 mmol) was added to a mixture of dichloromethane (50 mL) and concentrated ammonium hydroxide (100 mL) at room temperature and the combination was allowed to stir overnight. The resulting mixture was filtered and the organic and aqueous layers were separated. The organic layer was concentrated by evaporation and the solid residue obtained was washed with water and a little ether and then dried to obtain 6.7 g of the title compound as a white powder melting at 223-224°C.

62. Preparation of 2-Amino-6-chloro-3-methoxypyridine.

Sodium hydroxide (6.1 g, 196 mmol) was dissolved in water (75 mL) and cooled in an ice bath. Chlorine (3.8 g, 53 mmol) was added slowly with stirring keeping the temperature below 5°C. 6-Chloro-3-methoxy-picolinamide (6.1 g, 33 mmol) was added to this solution and the mixture was stirred at 0°C for 4 hours (until the solids had dissolved). The reaction mixture was acidified with acetic acid and extracted with dichloromethane. The organic extract was concentrated by evaporation and the residue obtained was diluted with hexane. The resulting slurry was filtered and the solids collected were dried to obtain 4.1 g of the title compound as a tan powder melting at 134-135°C.

Elemental Analysis for $C_6H_7ClN_2O$

Calc.: %C, 45.4; %H, 4.45; %N, 17.7

Found: %C, 45.2; %H, 4.58; %N, 17.4

63. Preparation of N-(6-Chloro-3-methoxy-2-pyridinyl)-N'-carboethoxy-thiourea.

Ethoxycarbonyl isothiocyanate (3.7 mL, 4.1 g, 31.5 mmol) was added slowly with stirring to a solution of 2-amino-6-chloro-3-methoxy-pyridine (5.0 g, 31.5 mmol) in chloroform (40 mL) and the mixture was stirred overnight. The solvent was removed by evaporation and the residue obtained was mixed with hexane. The resulting slurry was filtered and the solids collected were washed with a small amount of ether and dried to obtain 8.3 g of the title compound as a tan powder melting at 184-185°C with decomposition.

The following compounds were prepared by analogous procedures from known 2-aminopyridine compounds:

N-2-Pyridinyl-N'-carboethoxythiourea (a yellow powder melting at 94-96°C).

N-(6-Chloro-2-pyridinyl)-N'-carboethoxythiourea (a pale yellow powder melting at 73-74°C).

N-(3-Methoxy-2-pyridinyl)-N'-carboethoxythiourea (a pale yellow powder melting at 147-148°C).

N-(3,6-Dichloro-2-pyridinyl)-N'-carboethoxy thiourea (a yellow powder melting at 159-161°C).

Elemental Analysis $C_9H_9Cl_2N_3O_2S$

Calc.: %C, 36.8; %H, 3.08; %N, 14.3; %S, 10.9

Found: %C, 36.9; %H, 2.88; %N, 14.4; %S, 10.7

N-(3,5-Dichloro-2-pyridinyl)-N'-carboethoxythiourea (a yellow powder).

Elemental Analysis $C_9H_9Cl_2N_3O_2S$

Calc.: %C, 36.8; %H, 3.08; %N, 14.3; %S, 10.9

Found: %C, 36.5; %H, 3.36; %N, 14.4; %S, 11.1

N-(3-Fluoro-5-trifluoromethyl-2-pyridinyl)-N'-carboethoxy-thiourea. (a white powder melting at 86-90°C).

Elemental Analysis $C_{10}H_9F_4N_3O_2S$

Calc.: %C, 38.6; %H, 2.91; %N, 13.5; %S, 10.3

Found: %C, 38.5; %H, 2.69; %N, 13.4; %S, 10.2

N-(3-Bromo-5-methyl-2-pyridinyl)-N'-carboethoxythiourea (a yellow powder melting at 148-150°C).

Elemental Analysis $C_{10}H_{12}BrN_3O_2S$

Calc.: %C, 37.8; %H, 3.80; %N, 13.2; %S, 10.1

Found: %C, 37.8; %H, 3.72; %N, 13.1; %S, 10.1

64. Preparation of 2-Amino-5-chloro-8-methoxy[1,2,4]triazolo[1,5-a]-pyridine.

Hydroxylamine hydrochloride (9.6 g, 138 mmol) and diisopropyl-ethylamine (14.4 mL, 10.7 g, 83 mmol) were mixed with ethanol (300 mL) for a few minutes and then N-(6-chloro-3-methoxy-2-pyridinyl)-N'-carboethoxy-thiourea (7.6 g, 27.5 mmol) was added with stirring. The resulting mixture was stirred at room temperature for 20 min and then heated to reflux for 3 hours. The volatile components were removed by evaporation and the residue obtained was mixed with water. The resulting slurry was filtered and the solids collected were washed with ether, a small amount of methanol, and finally hexane and were then dried. The title compound (3.2 g) was

obtained as a tan powder melting at 207-208°C.
Elemental Analysis $C_7H_7ClN_4O$
Calc.: %C, 42.3; %H, 3.55; %N, 28.2
Found: %C, 41.7, %H, 3.91; %N, 27.9

The following compounds were prepared by analogous procedures from the products of Example 63:

2-Amino[1,2,4]triazolo[1,5-a]pyridine (a yellow powder melting at 100-102°C).

2-Amino-5-chloro[1,2,4]triazolo[1,5-a]pyridine (an off-white powder melting at 212-213°C).
Elemental Analysis $C_6H_5ClN_4$
Calc.: %C, 42.7; %H, 2.99; %N, 33.2
Found: %C, 42.7; %H, 3.01; %N, 33.6

2-Amino-8-methoxy[1,2,4]triazolo[1,5-a]pyridine (a light tan powder melting at 204-206°C).
Elemental Analysis $C_6H_8N_4O$
Calc.: %C, 51.2; %H, 4.91; %N, 34.1
Found: %C, 51.3; %H, 6.09; %N, 33.8

2-Amino-5,8-dichloro[1,2,4]triazolo[1,5-a]pyridine (a white powder melting at 236-238°C).
Elemental Analysis $C_6H_4Cl_2N_4$
Calc.: %C, 35.5; %H, 1.99; %N, 27.6
Found: %C, 35.6; %H, 2.12; %N, 27.4

2-Amino-6,8-dichloro[1,2,4]triazolo[1,5-a]pyridine (a white powder melting above 280°C).
Elemental Analysis $C_6H_4Cl_2N_4$
Calc.: %C, 35.5; %H, 1.99; %N, 27.6
Found: %C, 35.8; %H, 1.96; %N, 27.3

2-Amino-8-fluoro-6-trifluoromethyl[1,2,4]triazolo[1,5-a]-pyridine (an off-white powder melting at 221-224°C).
Elemental Analysis $C_7H_4F_4N_4$
Calc.: %C, 38.2; %H, 1.83; %N, 25.5
Found: %C, 38.1; %H, 2.04; %N, 24.1

2-Amino-8-bromo-6-methyl[1,2,4]triazolo[1,5-a]pyridine (a white powder melting above 280°C).

Elemental Analysis $C_7H_7BrN_4$

Calc.: %C, 37.0; %H, 3.11; %N, 24.7

Found: %C, 37.0; %H, 3.14; %N, 24.7

65. Preparation of 2-Benzylthio-5-chloro-8-methoxy[1,2,4]triazolo[1,5-a]pyridine.

t-Butyl nitrite (6.7 mL, 5.2 g, 50 mmol) was added all at once to a mixture of 2-amino-5-chloro-8-methoxy[1,2,4]triazolo[1,5-a]pyridine (5.0 g, 25 mmol) and dibenzyl disulfide (18.6 g, 75 mmol) in acetonitrile (250 mL) at 35°C with stirring. The reaction was exothermic, but a mantle was placed under the reaction flask to heat it to reflux rapidly. The evolution of gas began immediately and stopped after about 15 minutes. The volatiles were removed by evaporation and the residue was purified by column chromatography on silica gel eluting with 30 percent ethyl acetate in hexane. The dibenzyl disulfide eluted first followed by the title compound. The solvent was removed by evaporation and the residue was mixed with hexane and filtered. The collected solids were dried to obtain 6.1 g of the title compound as a light tan powder melting at 99-100°C.

Elemental Analysis $C_{14}H_{12}ClN_3OS$

Calc.: %C, 55.0; %H, 3.96; %N, 13.7; %S, 10.5

Found: %C, 54.9; %H, 4.08; %N, 13.9; %S, 10.5

2-Benzylthio-5-chloro[1,2,4]triazolo[1,5-a]pyridine (a pale yellow powder melting at 65-66°C) was prepared by an analogous procedure.

Elemental Analysis $C_{13}H_{10}ClN_3S$

Calc.: %C, 56.6; %H, 3.66; %N, 15.2; %S, 11.6

Found: %C, 56.7; %H, 3.56; %N, 15.4; %S, 11.5

66. Preparation of 2-Chlorosulfonyl-5-chloro-8-methoxy[1,2,4]triazolo-[1,5-a]pyridine.

Chlorine (6.7 g, 96 mmol) was added slowly with stirring at 3-7°C to a mixture of 2-benzylthio-5-chloro-8-methoxy[1,2,4]triazolo-[1,5-a]pyridine (6.5 g, 21 mmol) in dichloromethane (75 mL) and water (75 mL) and the reaction mixture was stirred for a 30 min period after the chlorine had been added. The layers were separated and the organic layer was dried over a mixture of magnesium and sodium sulfates and concentrated by evaporation under reduced pressure. The residue obtained was triturated with hexane, filtered, and dried to obtain 5.2 g of the title compound as a light tan powder melting at 149-151°C.

67. Preparation of N-(2,6-Difluorophenyl)-5-chloro-8-methoxy[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide.

Dimethyl sulfoxide (90 microliters, 94 micrograms, 1.2 mmol) was added with stirring to a solution of 2-chlorosulfonyl-5-chloro-8--methoxy[1,2,4]triazolo[1,5-a]pyridine (1.7 g, 6 mmol), 2,6-difluoroaniline (1.6 g, 12 mmol) and pyridine (0.5 g, 6 mmol) in acetonitrile (20 mL) at ambient temperature. The reaction was complete in about 30 min. Dichloromethane and water were added and the solid that separated was collected by filtration. The organic layer was concentrated by evaporation and the residue obtained was washed with water and combined with the earlier obtained solid. The combined solids were then washed with ether and hexane and dried to obtain 1.4 g of the title compound as an off-white powder melting at 190-191°C (d).

Elemental Analysis $C_{13}H_9ClF_2N_4O_3S$

Calc.: %C, 41.7; %H, 2.42; %N, 15.0; %S, 8.56

Found: %C, 41.3; %H, 2.37; %N, 15.0; %S, 8.69

The following compounds were prepared by analogous procedures:

N-(2-Chloro-4-methoxy-3-pyridinyl)-5-chloro-8-methoxy[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide (a white powder melting at 253-254°C (d)).

Elemental Analysis $C_{13}H_{11}Cl_2N_5O_4S$

Calc.: %C, 38.6; %H, 2.74; %N, 17.3; %S, 7.90

Found: %C, 38.8; %H, 2.90; %N, 17.4; %S, 7.47

N-(1-Methyl-4-bromo-3-pyrazoyl)-5-chloro-8-methoxy[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide (a light tan powder melting at 269-270°C (d)).

Elemental Analysis $C_{11}H_{10}BrClN_6O_3S$

Calc.: %C, 31.3; %H, 2.39; %N, 19.9; %S, 7.60

Found: %C, 31.9; %H, 2.39; %N, 19.6; %S, 7.60

68. Preparation of N-(2,6-Difluorophenyl)-5,8-dimethoxy[1,2,4]triazolo-[1,5-a]pyridine-2-sulfonamide.

N-(2,6-Difluorophenyl)-5-chloro-8-methoxy[1,2,4]triazolo-[1,5-a]pyridine-2-sulfonamide (1.0 g, 2.7 mmol), sodium methoxide (25 percent in methanol, 2.5 mL, 0.58 g, 11 mmol) and dimethyl sulfoxide (20 mL) were mixed with stirring and slowly heated to 70°C over a 40-min period. After a short reaction period, the reaction mixture was acidified with acetic acid and diluted with dichloromethane and water. The solid

that separated was recovered by filtration. The organic layer was separated, was washed several times with water, and was concentrated by evaporation under reduced pressure. The residue obtained was washed with water and combined with the previously obtained solid. The combined solids were washed with ether and hexane and dried to obtain 0.7 g of the title compound as an off-white powder melting at 319-320°C (d).

Elemental Analysis $C_{14}H_{12}F_2N_4O_4S$

Calc.: %C, 45.1; %H, 3.27; %N, 15.1; %S, 8.66

Found: %C, 43.4; %H, 3.13; %N, 14.8; %S, 8.23

The following compounds were prepared by analogous procedures from compounds of Example 68:

N-(2-Chloro-4-methoxy-3-pyridinyl)-5,8-dimethoxy[1,2,4]-triazolo[1,5-a]pyridine-2-sulfonamide (a light tan powder melting at 257-258°C (d)).

Elemental Analysis $C_{14}H_{14}ClN_5O_5S$

Calc.: %C, 42.1; %H, 3.53; %N, 17.7; %S, 8.02

Found: %C, 41.7; %H, 2.85; %N, 17.3; %S, 7.74

N-(1-Methyl-4-bromo-3-pyrazoyl)-5,8-dimethoxy[1,2,4]triazolo-[1,5-a]pyridine-2-sulfonamide (a tan powder melting at 257-258°C (d)).

Elemental Analysis $C_{12}H_{13}BrN_6O_4S$

Calc.: %C, 34.5; %H, 3.14; %N, 20.1; %S, 7.68

Found: %C, 34.1; %H, 2.98; %N, 19.8; %S, 7.27

69. Evaluation of Postemergence Herbicidal Activity

Seeds of the desired test plant species were planted in Grace-Sierra MetroMix® 306 planting mixture, which typically has a pH of 6.0 to 6.8 and an organic matter content of about 30 percent, in plastic pots with a surface area of 64 square centimeters. When required to ensure good germination and healthy plants, a fungicide treatment and/or other chemical or physical treatment was applied. The plants were grown for 7-21 days in a greenhouse with an approximately 15 hr photoperiod maintained at about 23-29°C during the day and 22-28°C during the night. Nutrients and water were added on a regular basis and supplemental lighting was provided with overhead metal halide 1000 Watt lamps as necessary. The plants were employed for testing after they reached the first or second true leaf stage.

A weighed amount, determined by the highest rate to be tested, of each test compound was placed in a 20 mL glass vial and was dissolved in 4 mL of a 97:3 (volume/volume) mixture of acetone and dimethyl sulfoxide to obtain concentrated stock solutions. If the test compound did not dissolve readily, the mixture was warmed and/or sonicated. The concentrated stock solutions obtained were diluted with an aqueous mixture containing acetone, water, isopropyl alcohol, dimethyl sulfoxide, Atplus 411F crop oil concentrate, and Triton X-155 surfactant in a 48.5:39:10:1.5:1.0:0.02 v/v ratio to obtain spray solutions of known concentration. The solutions containing the highest concentration to be tested were prepared by diluting 2 mL aliquots of the stock solution with 13 mL of the mixture and lower concentrations were prepared by dilution of appropriate smaller portions of the stock solution. Approximately 1.5 mL aliquots of each solution of known concentration were sprayed evenly onto each of the test plant pots using a DeVilbiss atomizer driven by compressed air pressure of 2 to 4 psi (140 to 280 kiloPascals) to obtain thorough coverage of each plant. Control plants were sprayed in the same manner with the aqueous mixture. In this test an application rate of 1 ppm results in the application of approximately 1 g/Ha.

The treated plants and control plants were placed in a greenhouse as described above and watered by sub-irrigation to prevent wash-off of the test compounds. After 2 weeks the condition of the test plants as compared with that of the untreated plants was determined visually and scored on a scale of 0 to 100 percent where 0 corresponds to no injury and 100 corresponds to complete kill. Some of the compounds tested, application rates employed, plant species tested, and results are given in Tables 2 and 2A.

TABLE 2

POSTEMERGENCE HERBICIDAL ACTIVITY

Cpd. No.	Rate, ppm	Cocklebur	Jimsonweed	Lambsquarters	Morningglory	Velvetleaf	Field Pansy	Wild Buckwheat	Blackgrass	Barnyard grass	Giant foxtail	Johnsongrass
1	62.5	20	70	70	95	95	30	90	0	0	0	0
2	62.5	95	80	70	95	100	40	90	0	0	0	0
3	125	85	70	85	80	95	30	80	20	20	0	20
4	125	100	80	20	70	100	75	75	0	0	0	0
5	62.5	85	50	90	50	95	85	0	0	0	0	0
6	125	0	0	25	50	85	100	0	25	0	0	0
7	125	98	70	70	70	80	100	75	70	50	50	70
8	3.9	100	50	85	70	65	60	70	100	80	25	93
9	31.3	90	95	70	90	98	100	85	85	80	70	75
10	500	80	80	20	40	80	100	40	80	70	0	0
11	125	80	40	20	80	85	95	50	20	50	35	0
12	250	90	90	60	80	95	100	70	80	98	60	80
13	15.6	75	70	90	100	98	100	85	80	90	50	90
14	250	100	100	60	100	80	100	90	80	98	85	70
15	1000	80	30	0	40	65	25	0	60	0	0	0
16	125	35	80	90	100	95	100	--	95	--	20	50
17	31.3	40	65	65	85	85	100	90	0	35	25	35
18	62.5	95	95	90	75	95	95	--	0	--	40	10
19	15.6	95	75	80	80	85	80	80	85	90	90	80
20	3.9	100	90	80	80	85	85	80	35	80	50	88
21	7.8	100	90	90	86	85	75	85	85	88	35	85
22	83.3	85	75	50	90	90	50	30	20	35	0	0
23	15.6	--	--	75	100	85	85	90	80	85	75	90
24	15.6	88	--	75	90	--	90	90	70	89	70	85
25	31.3	100	100	70	98	98	100	100	90	85	40	70
26	31.3	98	70	40	80	85	100	100	20	30	20	60
27	31.3	90	80	50	60	98	80	100	50	40	20	40
28	1.95	90	85	60	95	75	98	100	55	70	20	75
29	31.3	100	70	80	50	99	100	99	80	80	55	75
30	15.6	98	98	30	100	85	90	85	98	80	30	75
31	3.9	100	88	40	80	90	100	90	0	25	60	50

32	7.8	90	70	78	90	88	100	100	20	80	75	80
33	31.3	98	50	80	100	80	100	80	80	75	50	75
34	31.3	98	70	80	98	100	100	85	70	98	40	98
35	31.3	90	50	70	90	80	100	100	20	40	0	70
36	31.3	90	55	80	100	80	98	99	35	70	40	90
37	3.9	55	60	20	99	97	100	100	35	0	0	0
38	7.8	100	95	15	70	97	100	95	0	0	30	65
39	15.6	97	80	60	70	93	99	70	50	35	50	80
40	31.3	93	80	35	70	93	100	80	80	70	60	75
41	15.6	100	85	0	93	99	90	99	50	30	45	65
42	15.6	100	85	100	90	90	100	85	50	75	75	75
43	62.5	--	90	90	100	90	90	88	50	65	70	55
44	7.8	--	90	90	85	85	85	75	85	85	70	85
45	15.6	--	90	90	90	85	75	75	50	65	35	60
46	250	80	100	50	80	80	80	40	70	70	50	75
47	15.6	70	70	55	90	70	100	0	90	70	70	80
48	7.8	100	83	10	100	80	100	80	0	0	20	15
49	31.3	100	99	50	80	99	99	75	0	10	45	65
50	31.3	85	99	30	70	95	80	65	70	75	50	83
51	15.6	90	60	75	98	100	90	85	90	75	30	95
52	500	50	80	70	90	88	100	75	20	20	25	60
53	15.6	40	97	85	80	85	100	65	70	90	35	95
54	62.5	40	95	85	80	100	70	65	90	80	80	93
55	62.5	90	85	90	90	70	88	80	88	85	70	85
56	31.3	90	85	75	87	90	100	85	90	75	70	70
57	15.6	90	70	85	90	88	85	80	75	85	65	88
58	3.9	70	60	90	85	85	100	90	80	50	30	60
59	31.3	90	85	60	85	85	100	80	80	60	50	85
60	31.3	95	85	75	85	85	95	85	90	80	60	90
61	15.6	90	--	85	85	85	98	95	85	75	60	80
62	31.3	85	--	90	80	85	100	90	75	40	60	50
63	15.6	85	--	85	80	90	90	95	90	40	55	80
64	500	90	90	50	70	25	60	50	60	30	50	80
65	500	75	75	60	30	60	70	60	0	0	10	40
66	7.8	90	90	100	75	85	95	98	70	80	95	100
67	15.6	88	--	55	85	85	85	88	60	70	70	85
69	15.6	90	--	85	90	88	90	88	85	90	80	90
70	15.6	90	88	30	88	75	80	100	70	30	30	40
71	15.6	90	85	60	90	88	10	90	70	50	35	40
72	7.8	90	85	88	90	80	75	85	80	75	60	75
73	3.9	50	70	60	87	90	75	80	50	85	40	85

74	62.5	100	90	50	80	80	60	60	75	50	30
75	62.5	100	70	40	75	90	85	40	40	10	20	0
76	125	80	80	65	90	80	80	50	50	75	70	70
77	125	98	60	40	90	98	80	65	50	50	45	40
78	31.3	100	80	40	90	98	100	85	60	60	0	40
79	62.5	90	--	70	75	80	100	85	70	70	40	80
80	0.98	85	60	20	60	80	75	100	60	60	30	60
	7.8	100	100	75	90	100	90	98	98	78	40	75
81	1.95	95	80	60	98	75	100	95	80	75	40	80
82	31.3	100	90	70	98	85	100	100	95	98	80	98
83	31.3	100	100	90	90	90	100	100	88	90	85	100
84	7.8	100	30	90	90	90	100	85	90	80	50	80
85	15.6	80	60	70	80	90	80	50	90	75	50	98
86	3.9	90	80	70	55	50	100	80	95	75	75	40
87	125	60	50	75	75	85	70	--	75	75	20	70
88	31.3	80	80	100	75	85	85	85	80	65	40	90
89	125	100	85	50	85	80	95	80	30	60	40	40
90	15.6	100	85	75	60	70	--	40	50	40	30	50
91	3.9	85	90	40	85	60	60	75	60	80	20	90
92	125	100	80	75	85	85	85	90	80	85	50	85
93	500	100	75	60	75	60	30	40	40	10	20	0
94	62.5	100	85	25	85	50	60	40	70	30	30	60
95	125	100	--	70	100	75	97	83	20	5	40	20
96	0.49	90	80	10	70	80	80	65	10	0	0	10
97	62.5	90	90	80	80	90	95	85	70	88	60	80
98	1.95	85	80	60	100	97	80	75	50	60	0	80
99	125	90	50	60	40	80	100	60	50	40	20	30
100	250	99	--	30	60	93	10	85	30	70	20	10
101	15.6	100	80	80	98	70	80	75	80	90	75	90
102	1000	80	--	0	0	10	0	0	0	0	0	0
103	7.8	93	--	80	60	80	65	95	70	85	70	90
104	31.3	95	--	97	70	75	80	97	90	80	60	99
105	500	93	--	55	20	70	60	65	45	65	45	35
106	3.9	85	--	35	50	15	90	65	93	75	55	0
107	500	97	--	60	60	80	20	80	10	5	0	0
108	1.95	97	--	70	75	90	80	80	40	50	50	55
109	31.3	98	90	55	90	65	65	75	0	10	0	40
110	7.8	90	65	85	65	70	85	70	15	65	60	65
111	62.5	99	60	97	93	75	97	70	75	70	65	70
112	125	100	95	20	70	100	45	70	0	0	0	0
113	62.5	98	90	0	100	90	20	75	0	0	0	0

114	500	90	75	50	75	90	0	0	0	0	0	0	0
115	1.95	100	85	70	100	80	65	65	45	0	60	50	
116	3.9	97	70	85	97	95	75	--	25	65	0	60	
117	7.8	100	70	100	100	90	80	80	83	80	65	65	
118	62.5	100	90	60	85	80	60	80	0	75	30	80	
119	1000	100	15	0	--	0	70	0	0	35	0	0	
120	125	100	60	60	85	75	75	0	40	35	0	0	
121	62.5	100	85	40	98	78	80	78	75	70	65	70	
122	62.5	90	90	40	80	85	70	80	0	75	70	75	
123	15.6	90	90	70	80	75	90	75	60	75	80	55	
124	1000	75	80	0	80	30	75	50	0	30	0	0	
125	500	85	80	80	75	40	90	30	78	80	40	80	
126	15.6	100	85	80	98	80	50	80	0	0	50	0	
127	62.5	100	75	80	80	80	70	80	80	75	75	75	
128	31.3	85	90	75	75	80	90	80	75	60	60	75	
129	15.6	100	90	75	90	70	75	80	75	75	98	90	
130	31.3	--	100	60	80	75	85	60	90	80	--	80	
131	250	--	98	50	90	90	75	80	50	30	--	75	
132	3.9	--	100	30	85	90	80	80	85	55	--	75	
133	125	--	98	30	95	90	85	80	90	45	--	75	
134	15.6	90	80	95	90	70	85	--	50	70	20	50	
135	31.3	90	--	85	90	85	--	85	75	65	75	--	
136	125	70	90	80	90	75	80	80	75	75	0	70	
137	500	95	--	70	75	70	--	75	80	5	60	--	
138	31.3	90	90	90	80	80	70	80	98	85	70	95	
139	31.3	90	95	75	85	80	75	75	98	90	75	90	
140	31.3	80	90	95	85	75	75	85	75	75	60	75	
141	1000	70	80	60	70	40	75	75	20	20	0	40	
142	500	85	--	20	100	75	--	70	40	0	55	--	
143	250	95	--	0	90	75	--	70	--	0	30	--	
144	500	89	--	0	70	20	--	55	--	0	50	--	
145	7.8	100	--	89	90	88	--	65	75	65	30	--	
146	7.8	85	--	80	100	80	--	80	30	60	40	--	
147	31.3	80	--	60	90	80	--	88	80	80	75	--	
148	31.3	98	--	90	75	95	--	75	75	80	80	--	
151	31.3	98	--	90	80	95	--	80	75	80	70	--	
152	1000	98	--	50	85	30	--	75	70	60	60	--	
153	62.5	88	--	75	100	85	--	80	65	55	70	--	
154	15.6	100	--	80	100	85	--	75	70	80	75	--	
155	6205	100	--	90	100	90	--	85	88	85	75	--	
156	125	85	--	85	80	70	--	80	85	80	80	--	

157	15.6	100	--	60	100	78	--	85	60	80	70	--
158	7.8	100	--	40	86	89	--	75	20	25	30	--
159	31.3	90	--	85	85	88	--	88	80	85	85	--
160	62.5	90	--	85	90	80	--	80	88	80	80	--
161	125	80	--	85	85	80	--	85	80	80	80	--
162	31.3	100	--	80	90	--	--	--	0	30	60	--
163	125	80	--	95	95	--	--	--	50	75	85	--
164	125	90	--	80	100	--	--	--	0	20	50	--
165	15.6	100	--	90	100	--	--	--	75	80	95	--
166	1.95	90	--	85	95	--	--	--	50	85	85	--
167	31.3	90	--	95	100	--	--	--	30	75	90	--
168	62.5	100	--	88	90	80	--	80	85	80	88	--
169	15.6	95	--	90	100	85	--	85	75	85	90	--
170	31.3	90	--	85	85	70	--	85	90	85	80	--
171	31.3	100	--	70	90	90	--	85	90	70	25	--
172	125	90	--	80	90	90	--	85	70	75	60	--
173	125	95	--	30	95	75	--	85	35	30	0	--
174	31.3	100	--	85	90	80	--	80	75	80	60	--
176	31.3	100	--	75	85	88	--	85	70	70	60	--
177	125	100	--	60	85	85	--	85	40	20	50	--
178	31.3	100	--	80	95	90	--	80	70	80	60	--
179	62.5	100	--	60	80	85	--	80	15	20	20	--
180	250	95	--	50	95	75	--	80	30	30	25	--
181	125	85	--	88	88	85	--	78	60	80	70	--
182	500	100	--	72	85	90	--	75	20	0	30	--
183	500	90	--	60	100	90	--	85	20	10	15	--
186	250	100	--	90	85	88	--	80	80	80	85	--
187	62.5	90	--	90	85	90	--	85	85	85	80	--
188	31.3	90	--	60	85	35	--	80	35	75	60	--
189	31.3	90	--	85	85	75	--	85	25	25	40	--
190	7.8	100	--	80	95	85	--	85	40	70	30	--
191	3.9	100	--	70	90	80	--	80	10	50	40	--
192	62.5	75	--	80	80	70	--	80	80	75	60	--
193	31.3	100	--	70	95	55	--	70	50	80	50	--
194	15.6	100	--	70	90	60	--	60	80	80	85	--
195	250	80	--	70	75	50	--	80	70	70	70	--
198	31.3	100	--	98	80	98	--	90	30	50	70	--
199	62.5	98	--	80	100	95	--	90	50	80	75	--
200	62.5	95	--	60	85	70	--	80	85	90	75	--
201	31.3	100	--	85	90	95	--	90	60	85	60	--
202	125	85	--	90	90	85	--	90	80	85	85	--

203	125	50	--	85	85	80	--	80	90	85	95	--
204	250	90	--	85	90	75	--	80	40	75	30	--
205	62.5	90	--	90	90	90	--	85	90	85	80	--
208	31.3	90	--	80	90	70	--	90	40	70	75	--
212	15.6	100	--	40	90	40	--	85	90	65	40	--

TABLE 2A

POSTEMERGENCE HERBICIDAL ACTIVITY

Cpd. No.	Rate, ppm	Chick-weed	Cockle-bur	Lambs-quarters	Morning-glory	Velvet-leaf	Field Pansy	Wild Buck-wheat	Black-grass	Barn-yard grass	Giant fox-tail	Rox Orange Sorghum
213	7.8	95	98	50	100	85	80	90	40	40	0	95
214	7.8	90	90	60	80	70	70	90	80	65	50	95
215	15.6	70	90	75	85	70	80	90	90	75	10	98
216	7.8	98	90	75	90	70	90	85	90	75	20	95
217	125	75	90	75	90	85	85	75	85	80	78	90
218	31.3	100	70	65	85	85	78	85	35	30	30	55
219	31.3	90	75	75	80	75	80	85	70	40	60	95
220	125	90	80	70	80	85	88	85	75	40	60	60
221	62.5	85	85	70	75	75	85	85	75	75	70	60
223	31.3	90	70	90	90	60	90	60	85	65	65	90
224	500	50	70	100	70	75	90	85	85	35	20	78
225	250	80	85	--	80	60	90	80	85	80	35	70
226	7.8	90	100	98	70	75	80	80	80	78	70	90
227	7.8	90	100	95	70	70	90	80	95	80	78	90
228	62.5	95	100	90	90	85	90	75	90	80	90	95
229	62.5	95	90	90	50	75	75	80	60	75	60	60
230	125	70	--	95	88	90	90	80	88	85	80	85
231	125	78	--	95	85	90	88	85	90	88	30	88
232	15.6	70	--	90	90	88	95	90	80	75	75	90
233	31.3	85	--	90	80	85	0	85	83	85	95	90
234	15.6	85	99	100	80	95	83	95	98	78	85	95
235	7.8	95	98	99	75	75	85	85	85	78	55	78
236	15.6	98	100	100	75	70	83	80	85	80	50	78
238	15.6	90	100	95	80	90	85	80	80	78	55	78
239	15.6	80	70	95	90	70	78	95	98	75	78	78
240	7.8	78	98	98	75	70	75	88	98	78	65	75
241	31.3	80	90	40	75	95	80	80	0	0	0	0
242	3.9	85	100	90	95	95	85	80	60	70	40	99
243	3.9	90	100	100	95	80	80	50	70	75	35	78
244	31.3	98	100	98	98	65	85	75	95	78	98	78
245	125	40	--	60	75	75	75	80	--	75	10	20

246	62.5	70	--	90	85	90	85	85	--	88	88	88
247	62.5	70	--	90	85	80	90	85	--	88	80	88
248	125	70	--	70	80	80	85	88	--	85	90	90
249	125	70	--	90	80	65	90	80	--	85	75	90
250	31.3	88	100	100	93	95	70	88	90	78	83	99
251	62.5	95	100	100	95	98	80	98	98	75	78	98
252	7.8	95	95	95	95	95	78	85	25	25	35	75
253	62.5	80	95	95	85	78	85	80	60	80	78	80
254	31.3	95	90	100	90	75	80	80	80	90	75	85
255	31.3	95	95	90	85	95	78	85	50	70	78	85
256	125	85	90	90	70	75	90	75	65	55	78	65
257	31.3	90	95	90	80	70	85	78	80	90	95	78
258	97.5	35	95	95	75	83	83	85	90	60	70	78

70. Evaluation of Preemergence Herbicidal Activity

Seeds of the desired test plant species were planted in a soil matrix prepared by mixing a loam soil which was composed of about 43 percent silt, 19 percent clay, and 38 percent sand and had a pH of about 8.1 and an organic matter content of about 1.5 percent and sand in a 70 to 30 ratio. The soil matrix was contained in plastic pots with a surface area of 161 square centimeters. When required to ensure good germination and healthy plants, a fungicide treatment and/or other chemical or physical treatment was applied.

A weighed amount, determined by the highest rate to be tested, of each test compound was placed in a 20 mL glass vial and was dissolved in 8 mL of a 97:3 v/v (volume/volume) mixture of acetone and dimethyl sulfoxide to obtain concentrated stock solutions. If the test compound did not dissolve readily, the mixture was warmed and/or sonicated. The stock solutions obtained were diluted with a 99.9:0.1 mixture of water and Tween® 155 surfactant to obtain application solutions of known concentration. The solutions containing the highest concentration to be tested were prepared by diluting 4 mL aliquots of the stock solution with 8.5 mL of the mixture and lower concentrations were prepared by dilution of appropriate smaller portions of the stock solution. A 2.5 mL aliquot of each solution of known concentration was sprayed evenly onto the soil of each seeded pot using a Cornwall 5.0 mL glass syringe fitted with a TeeJet TN-3 hollow cone nozzle to obtain thorough coverage of the soil in each pot. Control pots were sprayed in the same manner with the aqueous mixture. A highest application rate of 4.48 Kg/Ha is achieved when 50 mg of test compound is employed.

The treated pots and control pots were placed in a greenhouse with an approximately 15 hr photoperiod which was maintained at about 23-29°C during the day and 22-28°C during the night. Nutrients and water were added on a regular basis and supplemental lighting was provided with overhead metal halide 1000 Watt lamps as necessary. The water was added by top-irrigation. After 3 weeks the condition of the test plants that germinated and grew as compared with that of the untreated plants that germinated and grew was determined visually and scored on a scale of 0 to 100 percent where 0 corresponds to no injury and 100 corresponds to complete kill or no germination. Some of the compounds tested, application rates employed, plant species tested, and results are given in Table 3.

TABLE 3

PREEMERGENCE HERBICIDAL ACTIVITY

Cpd. No.	Rate, Kg/Ha	Morning-glory	Pigweed	Velvet-leaf	Wild Buck-wheat	Black-grass	Barn-yard Grass	Giant fox-tail	Johnson-grass	Wild oats
1	0.56	85	95	90	90	40	50	40	70	40
2	0.28	80	99	95	95	40	20	70	70	30
3	0.56	40	100	90	--	0	--	30	0	50
4	0.28	80	100	95	75	75	80	75	65	60
5	0.14	80	90	95	40	70	60	60	75	30
6	0.56	60	0	65	10	40	80	0	30	30
7	1.12	80	100	90	50	95	98	60	80	0
8	0.018	75	98	80	80	100	100	80	90	80
9	0.035	80	98	80	85	100	98	70	80	60
10	0.28	90	95	60	50	98	90	75	80	55
11	0.14	90	85	75	50	95	98	50	40	0
12	0.14	80	100	85	60	90	80	65	50	50
13	0.035	60	100	85	85	100	98	95	80	75
14	0.28	85	98	85	60	95	98	55	60	45
16	0.28	70	80	70	--	70	80	60	40	70
17	0.28	90	100	75	--	70	70	50	40	50
18	0.28	80	95	60	--	50	50	80	40	75
19	0.14	95	98	95	98	85	95	97	98	88
20	0.070	95	95	90	92	60	80	75	85	70
21	0.14	90	98	85	95	85	75	75	70	75
22	2.24	85	95	85	60	60	65	70	65	10
23	0.070	90	98	95	92	85	90	92	99	90
24	0.070	90	95	90	92	70	78	80	90	50
25	0.035	90	98	80	50	70	95	40	60	50
26	0.56	90	100	85	60	50	65	40	70	20
27	0.28	60	100	85	50	98	70	60	30	0
28	0.018	50	90	75	85	90	90	50	75	20
29	1.12	60	98	60	70	90	100	75	85	50
30	0.035	90	100	65	95	90	98	90	85	40
31	0.14	90	100	90	100	40	90	70	90	20
32	0.070	85	100	85	90	98	98	90	98	40

33	0.035	50	100	25	100	70	98	90	85		20
34	0.070	90	100	90	90	98	95	40	85		50
35	0.070	90	100	80	90	15	10	20	10		0
36	0.070	60	98	70	85	60	85	60	80		60
37	0.035	95	100	75	100	20	65	60	0		0
38	0.070	85	100	60	100	0	50	20	0		10
39	0.070	70	100	30	90	80	95	85	90		60
40	0.035	40	99	65	95	95	90	40	80		20
41	0.070	90	100	60	100	20	99	80	85		10
42	0.070	90	100	90	90	98	80	70	80		50
43	0.070	50	98	60	85	30	60	60	20		0
44	0.070	90	100	60	90	98	95	98	90		60
45	0.070	85	100	80	90	100	95	60	85		20
46	0.56	50	100	50	60	80	60	50	60		0
47	0.070	80	0	60	90	99	85	90	85		50
48	0.035	98	100	90	100	20	20	30	0		20
49	0.035	80	100	40	99	0	0	50	10		0
50	0.070	90	100	90	40	98	98	80	90		80
51	0.035	60	98	100	90	60	95	60	80		50
52	0.56	85	98	85	80	40	50	40	50		20
53	0.035	10	90	90	95	98	80	90	80		80
54	0.56	90	100	90	80	60	40	30	20		20
55	0.56	90	90	90	88	90	87	70	90		78
56	0.28	90	90	85	90	85	85	80	85		75
57	0.14	90	88	90	90	80	90	80	85		65
58	0.018	90	98	85	85	90	65	40	75		40
59	0.035	80	95	88	90	95	70	50	80		50
60	0.070	85	98	80	95	90	70	60	85		50
61	0.035	90	98	80	85	90	80	80	90		65
62	0.14	90	100	95	90	100	85	78	80		50
63	0.070	95	90	80	80	60	70	70	--		60
64	1.12	55	45	0	0	0	0	0	90		0
65	2.24	75	80	55	45	20	45	45	10		25
66	0.070	90	98	95	98	98	85	80	98		90
67	0.035	85	90	88	90	70	60	75	75		50
68	0.15	85	95	92	50	40	60	60	75		20
69	0.070	95	95	90	95	80	85	90	100		88
70	0.28	90	90	85	90	85	75	70	75		50
71	0.070	90	60	80	92	70	65	50	95		25
72	0.14	90	90	85	90	95	75	70	88		65
73	0.070	90	85	80	88	90	80	75	85		40

74	0.56	80	100	90	80	80	98	80	60	50
75	0.56	80	98	80	80	20	50	30	40	0
76	0.28	75	100	70	60	50	95	60	60	50
77	0.56	80	100	70	60	50	30	30	40	20
78	0.28	90	100	85	40	65	98	60	--	0
79	0.28	85	100	60	40	80	95	50	--	50
80	0.018	95	95	80	60	90	60	80	--	0
81	0.009 0.070	30 100	98 100	30 98	80 95	85 90	95 100	85 95	-- --	0 90
82	0.035	80	100	80	95	98	90	90	80	60
83	0.035	30	98	60	85	90	90	60	80	65
84	0.070	85	100	75	85	100	98	50	50	70
85	0.070	75	100	50	80	80	90	75	98	70
86	0.28	100	100	70	90	98	98	90	90	75
87	0.56	85	100	85	40	100	98	75	85	50
88	0.070	90	95	85	90	75	85	78	98	80
89	0.28	90	90	80	20	60	90	85	--	30
90	0.28	80	85	90	70	98	95	90	90	85
91	0.14	95	90	90	75	90	95	80	--	80
92	0.28	95	95	90	40	95	90	90	--	70
93	1.12	80	50	50	40	0	50	0	30	20
94	1.12	90	80	80	90	99	90	90	95	90
95	1.12	90	90	80	80	25	65	60	30	10
96	0.14	90	98	95	95	88	70	60	65	65
97	0.035	85	90	90	95	80	70	80	90	65
98	0.009 0.070	85 90	95 98	80 85	85 98	85 95	45 95	60 98	90 98	20 85
99	0.14	90	90	70	80	70	65	85	70	50
100	0.56	70	75	80	100	80	60	70	70	40
101	0.070	85	98	80	90	80	90	80	95	80
103	0.035	90	95	80	95	80	98	85	98	70
104	0.035	90	90	80	90	98	98	80	98	75
105	0.070	60	70	40	30	50	50	50	75	10
106	0.070	90	95	60	95	100	95	95	95	75
107	0.070	40	80	20	60	0	0	20	0	0
108	0.018	90	98	85	95	98	90	80	98	50
109	0.28	90	98	80	90	95	75	45	90	50
110	0.14	90	95	75	85	95	85	80	95	85
111	0.070	85	90	90	95	90	95	90	90	85
112	1.12	60	100	85	30	30	40	50	60	30
113	1.12	80	100	90	60	30	80	30	70	0

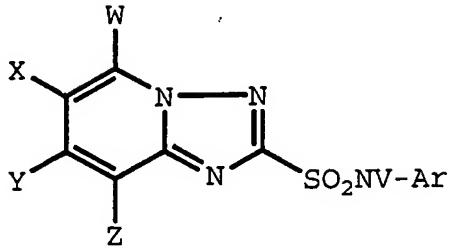
114	1.12	30	80	50	30	0	20	20	0	0
115	0.070	90	95	95	80	95	85	70	100	70
116	0.009	80	90	90	60	60	40	50	80	60
117	0.035	80	100	85	100	99	90	90	90	90
118	0.56	80	90	50	70	95	50	80	90	60
121	0.56	85	95	80	90	95	60	90	90	80
122	0.14	85	95	90	95	30	95	90	90	50
123	0.070	80	99	80	90	70	90	90	90	85
125	1.12	90	70	50	30	85	90	95	95	80
126	0.28	95	85	98	90	95	85	70	95	90
127	0.28	50	75	80	70	25	10	0	85	80
128	0.14	90	85	80	60	95	75	20	85	90
129	0.018	98	70	90	85	98	80	80	80	90
130	0.070	90	95	88	--	98	85	85	--	85
131	0.56	90	95	85	--	60	65	65	--	35
132	0.035	90	95	95	--	--	95	75	--	60
133	0.14	90	100	90	--	95	80	75	--	70
134	0.035	90	85	80	--	65	90	60	--	70
135	0.018	95	90	95	--	99	98	95	--	85
136	0.14	80	95	80	--	90	90	50	--	40
138	0.035	85	95	80	--	98	90	90	--	80
139	0.018	90	90	80	--	90	85	80	--	90
140	0.070	85	95	95	--	70	90	70	--	95
145	0.14	90	70	70	--	50	50	50	--	30
146	0.14	90	90	80	--	60	60	50	--	60
147	0.14	70	90	85	--	80	50	95	--	85
148	0.14	85	80	98	--	90	95	90	--	90
151	0.14	90	90	80	--	80	95	80	--	50
152	0.14	0	30	40	--	80	30	0	--	0
153	0.070	90	85	90	--	40	60	60	--	20
154	0.035	90	90	50	--	90	70	80	--	80
155	0.035	90	90	80	--	90	85	70	--	90
156	0.070	40	60	0	--	40	60	80	--	80
157	0.035	90	70	80	--	75	70	50	--	70
158	0.070	90	99	90	--	70	75	70	--	60
159	0.56	85	95	90	--	95	90	95	--	90
160	0.035	80	90	95	--	99	40	85	--	85
161	0.14	85	70	90	--	98	90	90	--	80
162	0.14	90	95	90	--	40	60	60	--	40
163	0.28	90	85	85	--	70	50	30	--	60
164	0.56	80	80	80	--	50	40	30	--	50

165	0.035	95	90	95	--	85	90	95	--	75
166	0.035	75	90	60	--	90	85	80	--	85
167	0.14	90	80	90	--	60	85	80	--	50
168	0.035	90	95	90	--	99	98	95	--	95
169	0.018	90	90	90	--	70	85	70	--	70
170	0.035	80	98	90	--	98	70	90	--	95
171	0.018	80	90	90	--	90	30	65	--	75
172	0.14	75	98	80	--	75	85	75	--	80
173	0.28	75	80	80	--	70	40	50	--	75
175	0.070	85	98	85	--	95	95	95	--	85
176	0.070	90	98	95	--	85	90	70	--	70
177	0.56	75	100	85	--	80	70	50	--	65
178	0.035	85	70	85	--	85	90	70	--	80
179	0.28	80	90	85	--	75	70	70	--	70
180	0.28	85	80	80	--	85	50	--	--	75
181	0.070	80	95	75	--	75	90	70	--	75
182	0.14	80	85	95	--	70	40	75	--	60
183	0.28	85	90	95	--	75	30	50	--	50
186	0.070	90	90	95	--	98	75	75	--	90
187	0.070	90	85	90	--	95	80	85	--	85
188	0.14	70	80	30	--	65	85	95	--	75
189	0.14	85	95	80	--	75	85	75	--	60
190	0.070	90	85	98	--	85	80	70	--	50
191	0.018	85	80	90	--	75	98	70	--	70
192	0.14	80	90	80	--	85	95	95	--	85
193	0.14	90	90	75	--	85	95	85	--	80
194	0.035	80	95	85	--	90	90	95	--	80
195	0.28	70	80	50	--	80	78	60	--	85
198	0.070	85	98	95	--	85	85	80	--	80
199	0.070	85	95	95	--	80	90	35	--	80
200	0.070	85	95	75	--	90	95	85	--	85
201	0.035	90	95	90	--	80	98	78	--	75
202	0.070	80	98	70	--	80	90	80	--	78
203	0.14	75	98	75	--	99	98	98	--	80
204	0.56	90	90	85	--	85	80	75	--	60
205	0.070	95	98	90	--	95	85	95	--	85
208	0.28	88	95	90	--	95	75	90	--	90
213	0.035	85	80	90	--	80	60	50	--	70
214	0.14	85	95	95	--	100	95	95	--	100
215	0.070	70	50	85	--	100	90	45	--	90
216	0.070	75	85	95	--	100	100	60	--	80

217	0.035	70	75	60	--	90	95	70	--	75
218	0.28	90	100	100	--	-90	78	60	--	90
219	0.28	90	70	95	--	100	100	60	--	98
220	0.56	30	60	75	--	75	25	65	--	90
221	0.28	40	90	75	--	100	75	95	--	85
223	0.28	80	95	95	--	--	73	95	--	80
224	0.28	50	60	75	--	--	0	40	--	40
225	0.28	80	80	90	--	--	70	78	--	90
226	0.070	80	95	90	--	--	98	95	--	95
227	0.035	70	80	78	--	--	85	90	--	90
228	0.14	80	90	80	--	--	95	90	--	80
229	0.56	80	85	80	--	--	95	85	--	80
230	0.28	90	100	95	--	--	70	70	--	90
231	0.14	85	90	90	--	--	75	70	--	90
232	0.14	90	90	90	--	--	95	80	--	90
233	0.035	70	98	80	--	90	85	90	--	80
234	0.14	90	95	90	--	90	95	95	--	95
235	0.14	90	98	95	--	90	90	90	--	85
236	0.14	90	80	85	--	100	90	90	--	85
238	0.28	85	95	85	--	90	90	80	--	85
239	0.14	80	95	90	--	90	90	95	--	80
240	0.070	85	95	80	--	95	90	80	--	80
241	0.28	90	90	95	--	--	78	70	--	80
242	0.14	95	100	90	--	--	80	75	--	100
243	0.070	90	98	80	--	100	100	95	--	90
244	0.14	90	95	80	--	90	90	95	--	90
245	0.28	85	85	80	--	--	90	70	--	70
246	0.070	90	95	78	--	--	80	90	--	85
247	0.28	85	100	85	--	--	95	95	--	95
248	0.28	75	98	75	--	--	90	90	--	90
249	0.56	80	98	70	--	--	90	95	--	90
250	0.070	80	95	90	--	85	95	90	--	80
251	0.070	78	95	90	--	80	95	78	--	80

WHAT IS CLAIMED IS:

1. An N-aryl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide compound of the formula:

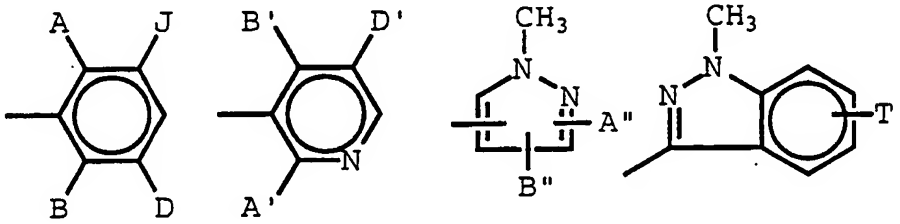


wherein

W, X, Y, and Z each independently represents H, CH_3, CH_2CH_3, CH_2OCH_3, CF_3, F, Cl, Br, I, OCH_2CF_3, $S(C_1-C_3)$alkyl, or $O(C_1-C_3)$alkyl optionally monosubstituted with F, Cl, or OCH_3, with the proviso that at least one of W, X, Y, and Z represents H;

V represents H, COR', CO_2R'', or CONR''2;

Ar represents an aromatic moiety one of the formulas:



A represents F, Cl, Br, CO_2R'', CONR''2, (C_1-C_2)haloalkyl, NO_2, CN, SOR', or SO_2R';

B represents H, CH_3, C_2H_5, F, Cl, Br, CN, OR', SR', NR''2, phenyl, or phenoxy, each phenyl and phenoxy optionally possessing 1 to 3 substituents selected from the group consisting of F, Cl, Br, CN, CF_3, NO_2, and CH_3;

D and J each independently represents H or CH_3 with the proviso that at least one of D and J represents H;

A' and B' each independently represents H, R', OR', OCH_2CH_2Cl, $OCH_2CH_2OCH_3$, $S(O)_nR'$, F, Cl, Br, I, CN, NO_2, C_6H_5, CO_2R'', or CONR''2 with the proviso that not more than one of A' and B' represents H;

D' represents H, F, Cl, Br, I, CF_3, or CH_3;

A" represents F, Cl, Br, I, CF_3, SCF_3, CN, $CO_2R"$, or $CONR'"_2$ and is located in the 4-position when the point of attachment is the 3- or 5-position and represents F, Cl, Br, I, CF_3, or CH_3 and is located in the 3- or 5-position when the point of attachment is the 4-position;

B" represents H when the point of attachment is the 3- or 5-position and represents H, Cl, Br, F, CH_3, or OCH_3 and is located the 3- or 5-position not occupied by A" when the point of attachment is the 4-position;

T represents H or F;

n represents 0, 1, or 2;

R' represents (C_1-C_4)alkyl optionally singly to completely substituted with fluorine;

R" represents (C_1-C_4)alkyl, (C_3-C_4)alkenyl, or (C_3-C_4)alkynyl;

R"' represents H or (C_1-C_4)alkyl; and

wher. V represents H, the agriculturally acceptable salts thereof.

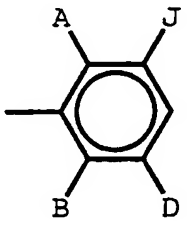
2. A compound according to Claim 1 wherein V represents H or an agriculturally acceptable salt thereof.

3. A compound according to Claim 1 wherein two of W, X, Y, and Z represent H.

4. A compound according to Claim 1 wherein one or both of W and Z represents OCH_3 or wherein W represents OCH_2CH_3 or $OC_3H_7(i)$.

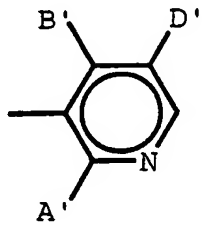
5. A compound according to Claim 4 wherein W represents methoxy, ethoxy, or isopropoxy, X and Z each represent hydrogen, and Y represents methyl or a halogen; or wherein W represents methoxy or ethoxy, X and Y each represent hydrogen, and Z represents methyl, methoxy, or a halogen; or wherein Z represents methoxy or ethoxy, W and Y each represent hydrogen, and X represents methyl, trifluoromethyl, or a halogen.

6. A compound according to Claim 1 wherein Ar represents:



wherein A represents F, Cl, Br, CF_3, NO_2, or CO_2CH_3; B represents F, Cl, Br, OCH_3, or CH_3, and J represents H; and D represents H or CH_3.

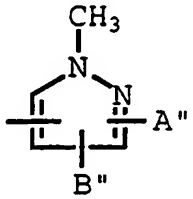
7. A compound according to Claim 1 wherein Ar represents:



wherein A' represents CH_3, $O(C_1-C_3)$alkyl, F, Cl, Br, or I; B' represents F, Cl, Br, I, CH_3, C_2H_5, CF_3, $O(C_1-C_3)$alkyl, $OCH(CH_3)CF_3$, OCH_2CH_2F, OCH_2CHF_2, or $CO_2(C_1-C_3)$alkyl; and D' represents H.

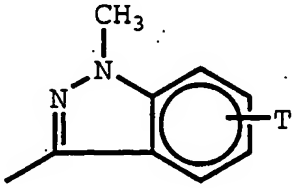
8. A compound according to Claim 7 wherein A' represents Br, Cl, F, or OCH_3, B' represents CH_3, OCH_3, OC_2H_5, $OC_3H_7(n)$, $OC_3H_7(i)$, $OCH(CH_3)CF_3$, or OCH_2CH_2F, and D' represents H; or wherein A' represents OCH_3 or OC_2H_5, B' represents $CO_2(C_1-C_2)$alkyl, Br, Cl, or F, and D' represents H.

9. A compound according to Claim 1 wherein Ar represents:



wherein A" represents Cl, Br, I, or CF_3 and B" represents H.

10. A compound according to Claim 1 wherein Ar represents:



wherein T represents 4-F.

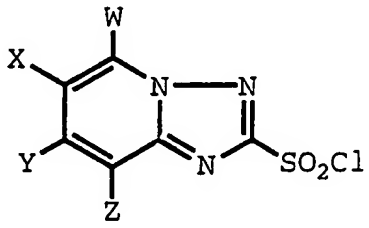
11. A compound according to Claim 1 which is selected from N-(4-bromo-1-methyl-3-pyrazolyl)-8-methoxy[1,2,4]triazolo[1,5-a]pyridine-2--sulfonamide, N-(2,6-dichlorophenyl)-6-bromo-8-methoxy[1,2,4]triazolo-

[1,5-a]pyridine-2-sulfonamide, N-(2,6-difluorophenyl)-8-chloro-5-methoxy-[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, N-(2-fluoro-4-methyl-3--pyridinyl)-7-chloro-5-methoxy[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide, and N-(2-chloro-4-methyl-3-pyridinyl)-5-methoxy-7-methyl[1,2,4]triazolo-[1,5-a]pyridine-2-sulfonamide.

12. An herbicidal composition characterized by containing an agriculturally acceptable adjuvant or carrier and an herbicidally effective amount of an N-aryl[1,2,4]triazolo[1,5-a]pyridine-2-sulfonamide compound of any one of Claims 1-11.

13. A method of controlling undesirable vegetation which is characterized by applying to said vegetation or to the locus thereof an herbicidally effective amount of an N-aryl[1,2,4]triazolo[1,5-a]pyridine-2--sulfonamide compound of any one of Claims 1-11.

14. A halosulfonyl compound of the formula:



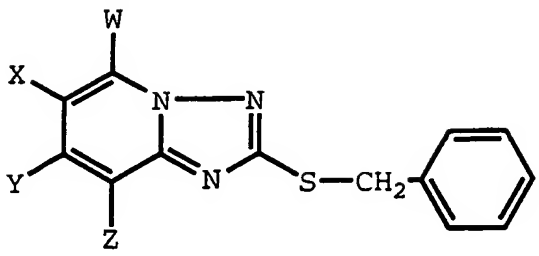
wherein W, X, Y, and Z each independently represents H, CH_3, CH_2CH_3, CH_2OCH_3, CF_3, F, Cl, Br, I, OCH_2CF_3, or $O(C_1-C_3)$alkyl optionally monosubstituted with F, Cl, or OCH_3 with the proviso that at least one of W, X, Y, and Z represents H.

15. A compound according to Claim 14 wherein two of W, X, Y, and Z represent H.

16. A compound according to Claim 15 wherein one or both of W and Z represents Cl or OCH_3 or wherein W represents OCH_2CH_3 or $OC_3H_7(i)$.

17. A compound according to Claim 16 wherein W represents chloro, methoxy, ethoxy, or isopropoxy, X and Z each represent hydrogen, and Y represents methyl or a halogen; or wherein W represents chloro, methoxy or ethoxy, X and Y each represent hydrogen, and Z represents methyl, methoxy, or a halogen; or wherein Z represents chloro, methoxy or ethoxy, W and Y each represent hydrogen, and X represents methyl, trifluoromethyl, or a halogen.

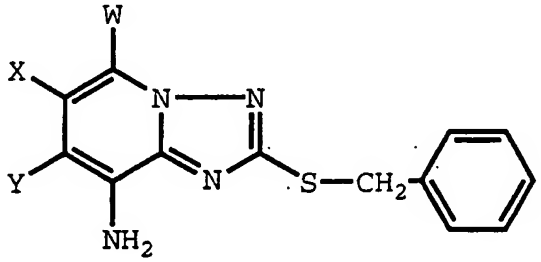
18. A benzylthio compound of the formula:



wherein W, X, Y, and Z each independently represents H, CH_3, CH_2CH_3, CH_2OCH_3, CF_3, F, Cl, Br, I, OCH_2CF_3, or $O(C_1-C_3)$alkyl optionally monosubstituted with F, Cl, or OCH_3 with the proviso that at least one of W, X, Y, and Z represents H.

19. A compound according to Claim 18 wherein W represents chloro, methoxy, ethoxy, or isopropoxy, X and Z each represent hydrogen, and Y represents methyl or a halogen; or wherein W represents chloro, methoxy or ethoxy, X and Y each represent hydrogen, and Z represents methyl, methoxy, or a halogen; or wherein Z represents chloro, methoxy or ethoxy, W and Y each represent hydrogen, and X represents methyl, trifluoromethyl, or a halogen.

20. A process for the preparation of an amino compound of the formula:



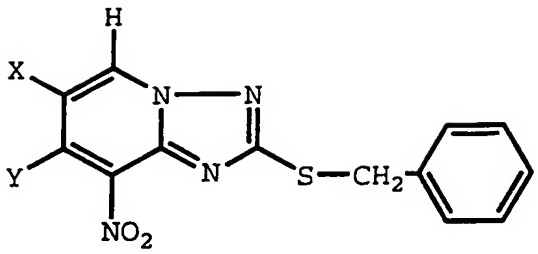
wherein

W represents Cl or (C_1-C_3)alkoxy;

X represents H; and

Y represents H, F, Cl, Br, I, or CH_3

which process is characterized by reducing the corresponding nitro compound of the formula:



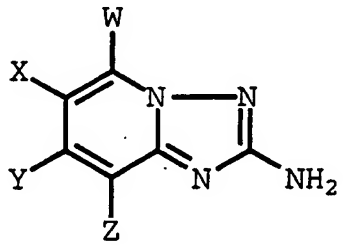
wherein

X represents H and

Y represents H, F, Cl, Br, I, or CH_3

with stannous chloride at a temperature of about 50°C to about 120°C with good agitation in the presence of a reactive medium comprising stannic chloride and either hydrogen chloride or a C_1-C_3 alcohol and, thereafter, basifying the product obtained to obtain said amino compound wherein W represents Cl or (C_1-C_3)alkoxy, respectively.

21. A 2-amino[1,2,4]triazolo[1,5-a]pyrimidine compound of the formula:



wherein W, X, Y, and Z each independently represents H, CH_3, CH_2CH_3, CH_2OCH_3, CF_3, F, Cl, Br, I, OCH_2CF_3, or O(C_1-C_3)alkyl optionally monosubstituted with F, Cl, or OCH_3 with the proviso that at least one of W, X, Y, and Z represents H.

22. A compound according to Claim 21 wherein two of W, X, Y, and Z represent H.

23. A compound according to Claim 22 wherein one or both of W and Z represents Cl or OCH_3 or wherein W represents OCH_2CH_3 or OC_3H_7(i).

24. A compound according to Claim 23 wherein W represents chloro, methoxy, ethoxy, or isopropoxy, X and Z each represent hydrogen, and Y represents methyl or a halogen; or wherein W represents chloro, methoxy or ethoxy, X and Y each represent hydrogen, and Z represents methyl, methoxy, or a halogen; or wherein Z represents chloro, methoxy or

ethoxy, W and Y each represent hydrogen, and X represents methyl, trifluoromethyl, or a halogen.

25. A compound according to Claim 24 which is 2-amino-5--chloro-8-methoxy[1,2,4]triazolo[1,5-a]pyrimidine.

INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/US 95/08609

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C07D471/04 A01N43/90 //(C07D471/04,249:00,221:00)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C07D A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 244 948 (SCHERING) 11 November 1987 cited in the application see claims 1,9	1,12
X	CHEMICAL ABSTRACTS, vol. 97, no. 15, 1982 Columbus, Ohio, US; abstract no. 127572w, V.A. CHUIGUK ET AL. 'Mesoionic heterocy<cles based on 2-amino-1,2,4-triazolo[1,5-a]pyridine' page 721; see compound I & UKR. KHIM. ZH. , vol. 48, no. 6, 1982 pages 647-649,	21,22

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 September 1995	-6. 10. 95

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Alfaro Faus, I

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int ional Application No
PCT/US 95/08609

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-244948	11-11-87	AU-B-	573130	26-05-88
		AU-A-	7220987	03-12-87
		JP-A-	62263168	16-11-87
		SU-A-	1644719	23-04-91